

Chemistry: Chapter 16 Indicators and pH

Combined Science (Chemistry Part): Chapter 16 Indicators and pH

Section 16.1

|!|EMA041616001O|!

Which of the following solutions are neutral?

- (1) HCl(aq)
 - (2) NaCl(aq)
 - (3) NaOH(aq)
 - (4) Na₂SO₄(aq)
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (4) only
 - D. (3) and (4) only



##C##

|!|EMB041616002O|!

Arrange the following solutions in ascending order of pH values:

- (1) 1 M KHCO₃(aq)
 - (2) 1 M HNO₃(aq)
 - (3) 1 M KOH(aq)
 - (4) 0.1 M KOH(aq)
- A. (1),(2),(3),(4)
 - B. (2),(1),(4),(3)
 - C. (2),(4),(3),(1)
 - D. (3),(4),(1),(2)



##B##

|!|EMB041616003O|!

Which of the following elements burns in air to form an oxide that gives a solution with a pH value smaller than 7 when shaken with water?

- A. Sulphur
- B. Iron
- C. Zinc
- D. Hydrogen



##A Sulphur burns to form sulphur dioxide which is acidic; while zinc oxide and oxides of iron do not dissolve in water. The oxide of hydrogen is water, which is neutral.##

!|EMA041616004O|!

One mole of each of the following substances is dissolved in water to make 1 dm³ solutions respectively. Which will have the highest pH value?

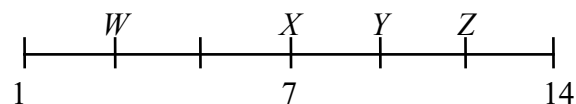
- A. Carbon dioxide
- B. Hydrogen chloride
- C. Sodium chloride
- D. Sodium hydroxide



##D Hydrogen chloride solution is acidic and has pH value below 7. Carbon dioxide dissolves in water to form carbonic acid, pH is below 7. Sodium chloride solution is neutral. Sodium hydroxide solution is alkaline with a pH value above 7.##

!|EMB041616005O|!

The pH scale below shows the position of four aqueous solutions *W*, *X*, *Y* and *Z* of equal concentration.



What could the aqueous solutions be?

	<u>Ethanoic acid</u>	<u>Potassium chloride</u>	<u>Ammonia</u>	<u>Sodium hydroxide</u>
A.	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>W</i>
B.	<i>Z</i>	<i>Y</i>	<i>X</i>	<i>W</i>
C.	<i>W</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
D.	<i>Y</i>	<i>Z</i>	<i>W</i>	<i>X</i>



##C *W* is acidic. *X* is a neutral substance and potassium chloride is a neutral salt. *Y* and *Z* are alkalis. *Z* is more alkaline than *Y* due to *Z* having a higher pH value.##

!|EMA041616006O|!

A sample of gas was bubbled into pure water. The pH value of the solution slowly changed from 7 to 10. Which of the following gases could it be?

- A. Carbon monoxide
- B. Nitrogen

- C. Ammonia
- D. Carbon dioxide



##C Ammonia dissolves in water and reacts with water to form an alkaline solution.

$\text{NH}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$. The others are either neutral or acidic gases.##

!|EMA041616007O|!

Which of the following substances has a pH value greater than 7 when dissolved in water?

- A. Orange juice
- B. Vinegar
- C. 'Milk of Magnesia'
- D. Grapefruit juice



##C 'Milk of Magnesia' is magnesium hydroxide which can dissolve very slightly in water to give a slightly alkaline solution.##

!|EMA041616008O|!

Which of the following statements about a neutral aqueous solution at room conditions is correct?

- A. $\text{H}^+(\text{aq})$ concentration $>$ $\text{OH}^-(\text{aq})$ concentration
- B. $\text{H}^+(\text{aq})$ concentration $=$ $\text{OH}^-(\text{aq})$ concentration
- C. $\text{H}^+(\text{aq})$ concentration $<$ $\text{OH}^-(\text{aq})$ concentration
- D. There is no $\text{H}^+(\text{aq})$ ion and $\text{OH}^-(\text{aq})$ ion.



##B##

!|EMA041616009O|!

Which of the following substances has a pH value above 7 at room conditions?

- A. Limewater
- B. Soft drinks
- C. Rainwater
- D. Orange juice



##A Limewater is a saturated aqueous solution of calcium hydroxide with the presence of hydroxide ions. Carbon dioxide dissolves in soft drinks which is acidic. Rainwater contains dissolved carbon dioxide and pH value is about 5.6. Orange juice

contains many acids such as citric acid, so it is also acidic.##

!!|EMA041616010O|!

In which of the following cases will the pH value increase when the second reactant is added to the first one?

- A. hydrochloric acid + magnesium
- B. sodium hydroxide solution + sulphuric acid
- C. ammonia solution + magnesium sulphate solution
- D. water + hydrochloric acid



##A Magnesium reacts with $\text{H}^+(\text{aq})$ ions in hydrochloric acid to form $\text{H}_2(\text{g})$. So $\text{H}^+(\text{aq})$ concentration is decreasing and pH is increasing. Addition of sulphuric acid to sodium hydroxide will decrease the pH of sodium hydroxide solution. Addition of magnesium sulphate will precipitate out the hydroxide ions as magnesium hydroxide, thus pH is decreased. Addition of hydrochloric acid to water will decrease the pH of water.##

!!|EMA041616011O|!

Four aqueous solutions have the pH values shown in the table.

Solution	<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>
pH	1	3	8	9

If pairs of the solutions are mixed, which pair must produce an alkaline mixture?

- A. *P* and *Q*
- B. *Q* and *R*
- C. *R* and *S*
- D. *P* and *S*



##C Both *R* and *S* are alkaline.##

!!|EMB041616012O|!

Which of the following solutions will have the lowest pH value?

- A. 2.0 M hydrochloric acid
- B. 1.0 M sulphuric acid
- C. 2.0 M ethanoic acid
- D. 2.0 M ammonium chloride solution



##A Although sulphuric acid is a dibasic strong acid, each hydrogensulphate ion

formed only slightly ionizes in water. Ethanoic acid only partially ionizes in water.##

!!|EMA041616013O|!

The pH value of a solution with $[H^+(aq)]$ being equal to $1.00 \times 10^{-3} \text{ mol dm}^{-3}$ is

- A. 3.
- B. 8.
- C. 11.
- D. 14.



##A $\text{pH} = -\log(1.00 \times 10^{-3}) = 3$ ##

!!|EMB041616014O|!

Solutions *P*, *Q*, *R* and *S* are four different solutions:

P: 0.01 M HCl solution

Q: 0.01 M H_2SO_4 solution

R: 0.01 M NH_4Cl solution

S: 0.01 M NH_3 solution

When these solutions are arranged in order of increasing acidity, the correct order is

- A. *P*, *S*, *R*, *Q*.
- B. *Q*, *R*, *S*, *P*.
- C. *S*, *R*, *P*, *Q*.
- D. *R*, *P*, *Q*, *S*.



##C##

!!|EMB041616015O|!

Solution *A* is an aqueous solution with pH 3 while solution *B* is an aqueous solution with pH 1. How does the $[H^+(aq)]$ in solution *A* compare with that in solution *B*?

- A. The $[H^+(aq)]$ in solution *A* is three times greater than the $[H^+(aq)]$ in solution *B*.
- B. The $[H^+(aq)]$ in solution *A* is one third of the $[H^+(aq)]$ in solution *B*.
- C. The $[H^+(aq)]$ in solution *A* is $\frac{1}{10}$ of the $[H^+(aq)]$ in solution *B*.
- D. The $[H^+(aq)]$ in solution *A* is $\frac{1}{100}$ of the $[H^+(aq)]$ in solution *B*.



##D Since $\text{pH} = -\log [H^+(aq)]$. If $\text{pH} = 3$, $[H^+(aq)] = 10^{-3} \text{ M}$; if $\text{pH} = 1$, $[H^+(aq)] =$

10^{-1} M. So, the ratio of $[H^+(aq)]$ in solution *A* to solution *B* is $\frac{10^{-3}}{10^{-1}} = \frac{1}{100}$.##

!!|EMA041616016O|!

Which of the following solutions, each at concentration of 1.0 M, has the highest pH value?

- A. HCl(aq)
- B. H₂SO₄(aq)
- C. NaCl(aq)
- D. FeCl₃(aq)



##C##

Section 16.2

!!|EMA041616017O|!

Which of the following combinations for acid-base indicators is correct?

	Acid-base indicator	Colour of the indicator in strongly acidic solutions	Colour of the indicator in strongly alkaline solutions
(1)	Litmus	Red	Blue
(2)	Methyl orange	Yellow	Orange
(3)	Phenolphthalein	Pink	Colourless

- A. (1) only
- B. (3) only
- C. (1) and (2) only
- D. (1) and (3) only



##A##

!!|EMB041616018O|!

The table below gives information about three indicators.

Indicator	Colour in strongly acidic solution	pH at which colour change	Colour in strongly alkaline solution
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Methyl orange	Red	3.1 – 4.4	Yellow
Congo red	Blue	5.0	Red
Phenolphthalein	Colourless	8.3 – 10.0	Red

Which of the following sets of colours would be obtained when each indicator was added separately to a sample of rainwater of pH 5.6?

	<u>Methyl orange</u>	<u>Congo red</u>	<u>Phenolphthalein</u>
A.	Red	Red	Red
B.	Yellow	Red	Colourless
C.	Yellow	Red	Red
D.	Red	Blue	Colourless



##B At such pH value, methyl orange is yellow, Congo red is red and phenolphthalein is colourless.##

!!|EMB0416160190|!!

The table below gives information about three indicators:

Indicator	Colour change Low pH to high pH	pH at which colour change takes place
Thymol blue	Red to yellow	3.0
Bromothymol blue	Yellow to blue	6.5
Phenolphthalein	Colourless to pink	9.0

If equal volumes of these three indicators were mixed, which colour would be observed at pH 4?

- A. Blue
- B. Green
- C. Orange
- D. Yellow



##D At pH 4, thymol blue is yellow; bromothymol blue is yellow and phenolphthalein is colourless. Hence, the resultant colour is yellow.##

!!|EMB0416160200|!!

The colour of indicator *X* in solutions of different pH values is shown below.

pH: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14



Colour: Red Green Blue

Indicator *X* would be possible for distinguishing

- A. aqueous solutions of sodium chloride and calcium hydroxide.
- B. aqueous solutions of hydrogen chloride and pure water.
- C. aqueous solutions of ammonia and sodium hydroxide.
- D. pure water and limewater.



##B The colour change at the pH range 3–4 differentiates between a strong acid and a neutral substance like pure water.##

!!|EMB041616021O|!

The following table gives information about two indicators:

Indicator	Colour change Low pH to high pH	pH at which colour change takes place
Methyl orange	Red to yellow	3.5
Methyl red	Red to yellow	5.5

The table shows the pH of four aqueous solutions.

Solution	<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>
pH	2.0	3.0	4.0	7.0

In which of the following solutions will both indicators appear yellow?

- A. *P* only
- B. *Q* and *R* only
- C. *R* and *S* only
- D. *S* only



##D Both indicators will be yellow at a pH value greater than 5.5.##

!!|EMA041616022O|!

Which of the following gases turns a moist red litmus paper blue?

- A. Sulphur dioxide
- B. Hydrogen sulphide
- C. Ammonia
- D. Chlorine



##C Ammonia, an alkali, turns red litmus paper blue. The other three gases are acidic.##

!!|EMA041616023O|!

Which of the following substances has a pH value below 7 at room conditions?

- A. 'Milk of Magnesia'
- B. Limewater
- C. Soap solution
- D. Vinegar



##D Vinegar is an aqueous solution of ethanoic acid.##

!|EMA041616024O|!

Which of the following substances is NOT used to test the acidity or alkalinity of aqueous solutions?

- A. Methyl orange
- B. Limewater
- C. Phenolphthalein
- D. Litmus



##B Limewater is used to test for carbon dioxide.##

Section 16.3

!|EMA041616025O|!

Which of the following acid-base indicators can be used to determine pH values most accurately?

- A. Universal indicator
- B. Methyl orange
- C. pH meter
- D. Phenolphthalein



##C##

!|EMA041616026O|!

The colours of the universal indicator in four sample solutions are summarized as follows:

Solution	Colour
<i>W</i>	Orange
<i>X</i>	Blue
<i>Y</i>	Green
<i>Z</i>	Red

Which of the following is the correct descending order in pH values of the solutions?

- A. W, X, Y, Z
- B. X, Y, Z, W
- C. Z, W, Y, X
- D. X, Y, W, Z



##D##

|!|EMA041616027O|!

Which of the following indicators is used to measure pH of aqueous solutions accurately?

- A. pH meter
- B. Universal indicator
- C. Methyl orange
- D. Litmus paper



##A##

|!|EMA041616028O|!

Which of the following statements are correct?

- (1) Hydrochloric acid can have a pH value of zero.
 - (2) pH paper contains more than one indicators.
 - (3) The pH value of an acidic solution increases when water is added to it.
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)



##D##

Each question below consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table:

- | |
|---|
| <ul style="list-style-type: none">A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.B. Both statements are true and the 2nd statement is NOT a correct explanation of the 1st statement. |
|---|

C. The 1st statement is false but the 2nd statement is true.

D. Both statements are false.

Section 16.1

|!|EMA041616029O|!

Unpolluted rainwater is acidic.

It contains dissolved carbon dioxide.

☐

##A##

|!|EMA041616030O|!

pH of limewater is higher than water.

The OH^- (aq) concentration is higher in limewater than that in water.

☐

##A##

|!|EMB041616031O|!

Addition of copper(II) sulphate solution to sodium hydroxide solution will cause a decrease in pH.

Copper(II) hydroxide is formed which is a blue insoluble solid.

☐

##B The hydroxide ions are precipitated out to form a blue precipitate, $\text{Cu}(\text{OH})_2$.##

Sections 16.2–16.3

|!|EMA041616032O|!

Universal indicator can measure the pH of aqueous solutions very accurately.

It gives different colours in different pH ranges.

☐

##C Universal indicator just gives a rough measure of pH, but not accurate one.##