

1. If the  $[H^+]$  is 0.0001 M, what is the pH?
2. If the  $[H^+]$  is 0.00001 M, what is the pOH?
3. If the pH is 4.5, what is the pOH?
4. What is the pH of a 0.025 M solution of hydrobromic acid (HBr)?
5. Suppose you test apple juice and find that the  $[H^+]$  as 0.0003. Find the pH value and determine whether the juice is acidic or basic.
6. You test some ammonia and determine the hydrogen ion concentration to be  $1.3 \times 10^{-9}$ . Find the pH value and determine whether the ammonia is basic or acidic.
7. The pH of very dilute HCl was found to be  $10^{-8}$  M.
8. If a solution is created by adding 100 mL of  $2.3 \times 10^{-4}$  M  $HNO_3$  solution and 100 mL of  $4.5 \times 10^{-3}$  M HCl solution, what could be the pH of the resultant solution?
9. Find the pH of a solution that contains 3.25 g of  $H_2SO_4$  dissolved in 2.75 litres of solution.
10. If a solution is created by adding  $2.3 \times 10^{-4}$  M NaOH solution and  $4.5 \times 10^{-6}$  M HCl solution, what could be the pH of the resultant solution?
11. What is the pOH of a 0.0235 M HCl solution?
12. What is the conjugate base pair of the following acids?  
A.  $HClO_4$       B.  $NH_4^+$       C.  $HCO_3^-$       D.  $H_2O$
13. What is the conjugate acid pair of the following bases?  
A.  $CN^-$       B.  $SO_4^{2-}$       C.  $HCO_3^-$       D.  $HPO_4^-$
14. A solution with a pH of 12 is how much more basic than a solution with a pH of 7?
15. A solution with a pH of 8 has how much more  $H^+$  ions than a solution with a pH of 12?
16. How much more acidic is a solution that has a pH of 3 than a solution that has a pH of 4?
17. The pH of a soft drink is determined to be 4.0. What is the  $[OH^-]$  of the drink?
18. What is the pOH of a solution whose  $[OH^-]$  is  $9.31 \times 10^{-2}$  M?
19. A sample of gastric juice has a pH of 2.5. What is the hydrogen ion concentration in this secretion?
20. Litmus paper can be used to determine if a solution is an acid or a base. There are two types of litmus paper. Red litmus paper will turn *blue* in the presence of a base. Blue litmus paper will turn *red* in the presence of an acid. Read the descriptions of the following solutions and **predict** what the litmus paper results should be. Write your answers below in the table.

| Predicted results of litmus paper tests on different solutions |                   |                    |                       |
|--|-------------------|--------------------|-----------------------|
| Solution   | Red litmus result | Blue litmus result | Acid, Base or Neutral |
| a) Solution with a pH of 4                                     |                   |                    |                       |
| b) Solution has equal amounts of $H^+$ ions and $OH^-$ ions    |                   |                    |                       |
| c) Seawater, pH 8.5  |                   |                    |                       |
| d) Distilled water (pure water)                                |                   |                    |                       |
| e) Coffee, pH 5.2  |                   |                    |                       |
| f) Solution with a pH of 7.0                                   |                   |                    |                       |
| g) Solution with a high concentration of $H^+$ ions            |                   |                    |                       |
| h) Solution with a pH of 11                                    |                   |                    |                       |
| i) Lime juice, pH 3.3  |                   |                    |                       |
| j) Solution with less $H^+$ ions than $OH^-$ ions              |                   |                    |                       |

KEY

1. 3
2. 9
3. 9.5
4. 1.6
5.  $\approx 2.4$
6. 8.8861
7. 6.9586
8. 2.6262
9. 1.9172
10. 10.35
11. 1.6289
12. A.  $ClO_4^-$       B.  $NH_3$       C.  $CO_3^{2-}$       D.  $OH^-$
13. A. HCN      B.  $HSO_4^-$       C.  $H_2CO_3$       D.  $H_2PO_4$
14.  $1 \times 10^{-5}$
15.  $1 \times 10^{-4}$
16.  $1 \times 10^{-1}$
17.  $1 \times 10^{-10}$
18. 1.0311
19.  $3.162 \times 10^{-3}$

20.

**Predicted results of litmus paper tests on different solutions**

| <b>Solution</b>  | <b>Red litmus result</b> | <b>Blue litmus result</b> | <b>Acid, Base or Neutral</b> |
|--|--------------------------|---------------------------|------------------------------|
| <b>a) Solution with a pH of 4</b>  | No change                | Red colour                | Acid                         |
| <b>b) Solution has equal amounts of H<sup>+</sup> ions and OH<sup>-</sup> ions</b> | No change                | No change                 | Neutral                      |
| <b>c) Seawater, pH 8.5</b>   | Blue colour              | No change                 | Base                         |
| <b>d) Distilled water (pure water)</b>   | No change                | No change                 | Neutral                      |
| <b>e) Coffee, pH 5.2</b>   | No change                | Red colour                | Acid                         |
| <b>f) Solution with a pH of 7.0</b>  | No change                | No change                 | Neutral                      |
| <b>g) Solution with a high concentration of H<sup>+</sup> ions</b>                 | No change                | Red colour                | Acid                         |
| <b>h) Solution with a pH of 11</b>   | Blue colour              | No change                 | Base                         |
| <b>i) Lime juice, pH 3.3</b>   | No change                | Red colour                | Acid                         |
| <b>j) Solution with less H<sup>+</sup> ions than OH<sup>-</sup> ions</b>           | Blue colour              | No change                 | Base                         |