

Range of acidity and basicity	$[\text{H}_3\text{O}^+(\text{aq})]$ (mol/L)	pH (= $-\log [\text{H}_3\text{O}^+(\text{aq})]$)	$[\text{OH}^-(\text{aq})]$ (mol/L)	pOH (= $14 - \text{pH}$)
	0.000 000 000 001	12	0.01	2
	0.000 000 000 000 1	13	0.1	1
very basic	0.000 000 000 000 01	14	1	0

Chapter 6 Review Answers

Student Textbook pages 244–245

Answers to Understanding Concepts Questions

- Acids: low pH, conductivity, sour taste
Bases: high pH, conductivity, bitter taste
- (a) According to the modified Arrhenius theory an acid must be capable of producing hydronium ions in solution, usually through the loss of hydrogen atoms. A base must be capable of producing hydroxide ions.
(b) The presence of hydronium or hydroxide ions makes the solutions conductive.
(c) An acid loses hydrogen atoms to water, forming hydronium ions.
(d) A base forms hydroxide ions in water.
(e) Strong acids and bases dissociate completely into hydronium and hydroxide ions, whereas weak acids and bases only produce small amounts of these ions.
(f) The pH of a solution is dependent on the concentration of hydronium ions.
(g) The pOH of a solution is dependent on the concentration of hydroxide ions.
- $\text{NaOH}(\text{aq}) + \text{HNO}_3(\text{aq}) \rightarrow \text{H}_2\text{O}(\ell) + \text{NaNO}_3(\text{aq})$
- (a) weak acid (b) weak acid
(c) strong base (d) weak base
- Diprotic means that the acid has two hydrogen ions (or protons) that it can donate in solution.
- $\text{H}_2\text{SO}_4(\text{aq})$ is a strong acid as it dissociates 100%. $\text{HSO}_4^-(\text{aq})$ dissociates less than 50% and is a weak acid.
- (a) basic (b) neutral (c) acidic
- An acid–base indicator is a substance that changes colour with a change in pH.
- Universal indicator undergoes many different colour changes with small changes in pH, whereas bromothymol blue only undergoes two, yellow to blue, with the solution turning green in between endpoints.
- Universal indicator relies on colour changes, which are a subjective measurement since they can change in intensity or under different lighting. Moreover, people tend to

classify shades of colours differently. Colour-blind people have problems distinguishing between different colours. A pH meter displays a calculated pH value, making it more accurate.

- (a) pH = 2.900, acid (b) pH = 5.450, acid
(c) pH = 12.010, base
- (a) pOH = 6.100, base (b) pOH = 6.631, base
(c) pOH = 9.290, acid
- (a) $[\text{H}_3\text{O}^+(\text{aq})] = 1.1 \times 10^{-5}$
(b) $[\text{H}_3\text{O}^+(\text{aq})] = 3 \times 10^{-11}$
(c) $[\text{H}_3\text{O}^+(\text{aq})] = 1.7 \times 10^{-11}$
(d) $[\text{H}_3\text{O}^+(\text{aq})] = 1 \times 10^{-12}$
(e) $[\text{OH}^-(\text{aq})] = 2.8 \times 10^{-3}$
(f) $[\text{OH}^-(\text{aq})] = 6 \times 10^{-3}$
(g) $[\text{OH}^-(\text{aq})] = 2 \times 10^{-7}$
(h) $[\text{OH}^-(\text{aq})] = 2 \times 10^{-3}$

Answers to Applying Concepts Questions

- The hydrochloric acid has the lowest pH as it is a strong acid, while the acetic acid has the next lowest since it is only a weak acid. The ammonia solution is a weak base and so has the highest pH.
- The low pOH of codeine indicates it has a high concentration of $\text{OH}^-(\text{aq})$ ions, making it a base.
- Diluting an acid tenfold raises the pH by a value of 1. Diluting one hundredfold raises it by 2. As you continue to dilute the acid, its pH will steadily approach 7. With further dilution the acid's pH will remain at 7, since the autoionization of water dominates.
- (a) 5.4–6.0 (b) 8.0–8.2 (c) 10–11.4
- (a) yellow (b) yellow–green (c) yellow
- The cheese is not safe to eat, since its pH of 7 is too high.
- Students ought to design a procedure to test pH and conductivity. The strong acid, strong base, and neutral ionic solutions should have a high conductivity. The weak acids and bases should have a low conductivity, while the neutral molecular solution should have no conductivity. The neutral solutions should have a pH of 7, the strong acid should have a low pH, while the weak acid should be just below 7. The strong base should have a high pH and the weak base should have a pH just above 7.
- When dealing with pH, or any logarithm, significant digits are counted after the decimal. For example, a pH value of 7.5 has only one decimal digit, while a pH value of 9.43 has two.
- This answer depends on the concentration of the two substances. At equal or similar concentrations, since the strong acid dissociates 100%, it generates far more hydronium ions than the weak acid, giving it a far greater reactivity, or strength. The weak acid would have to be