pOH = 1 ⇒ [OH⁻] = 1 × 10⁻¹

Multiple Choice Practice

3. How can 100. mL of sodium hydroxide solution with a pH of 13.00 be converted to a sodium hydroxide solution with a pH of 12.00? ⇒ pOH = 2 ⇒ [OH⁻] = 1 × 10⁻² ← dilute by a factor of 10!

   (a.) By diluting the solution with distilled water to a total volume of 1.00 L.

   b. By adding 100. mL of 0.10 M HCl.

   c. By diluting the solution with distilled water to a total volume of 200. mL

   d. By adding 100. mL of 0.10 M NaOH

4. The pH of a 500. mL solution of 0.60 M HCl if 500. mL of distilled water is added to the solution is closest to:

   a. 0 (b) 1 c. 3 d. 6

double volume ⇒ $\frac{0.60\,M}{2} = 0.30\,M \approx 1E-1\,M$ ⇒ pH = 1

5. How many liters of distilled water must be added to 1 liter of an aqueous solution of HCl with a pH of 1 to create a solution with a pH of 2?

   a. 0.1 L b. 0.9 L c. 2 L (d.) 9 L

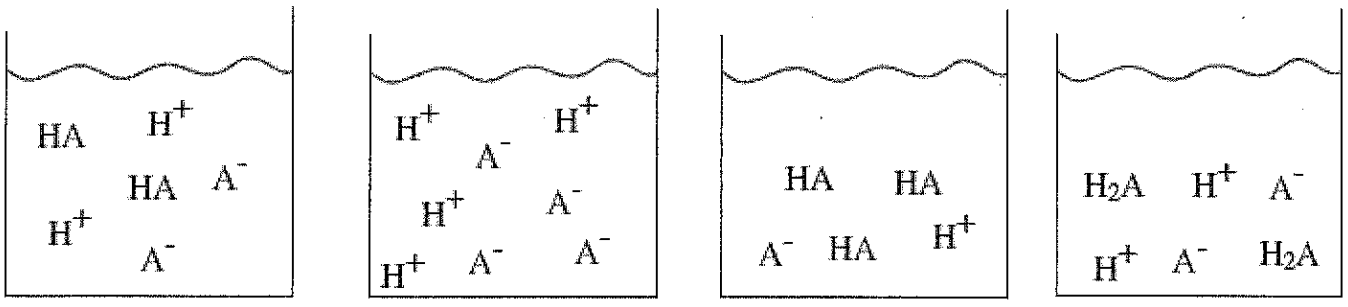
pH 1 → pH 2 ⇒ [H⁺] = 1E-1 M → 1E-2 M ⇒ dilute by a factor of 10!

6. Which change in the H^+ ion concentration of an aqueous solution represents a *decrease* of one unit on the pH scale?

   (a.) a tenfold increase c. a hundredfold increase

   b. a tenfold decrease d. a hundredfold decrease

7. Four different acids are added to beakers of water, and the following diagrams represent the species present in each solution at equilibrium. Which acid has the highest pH?



   a. Acid 1 b. Acid 2 (c.) Acid 3 d. Acid 4

↓[H⁺] = ↑pH

8. Estimate the pH of a 100. mL solution of 0.01 M NaOH if 900. mL of distilled water is added to the solution.

   a. 2 b. 3 (c.) 11 d. 12

9. A 1-molar solution of a very weak monoprotic acid has a pH of 5. What is the value of K_a for the acid?

(a.) 1×10^{-10} b. 1×10^{-7} c. 1×10^{-5} d. 1×10^{-2}

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} = \frac{x^2}{[HA]} = \frac{(1E-5)^2}{1} = 1E-10$$

10. A bottle of water is left outside early in the morning. The bottle warms gradually over the course of the day. What happens to the pH of the water as the bottle warms?

a. Nothing; pure water always has a pH of 7.00.

b. Nothing; the volume would have to change in order for any ion concentration to change.

c. It will increase because the concentration of H^+ is increasing.

(d.) It will decrease because the auto-ionization of water is an endothermic process.

★ can't do these yet! ★

11. A weak monoprotic acid, HA, has a pH of 5.00 when [HA] = 0.25 M. Calculate the ionization constant of this acid.

a. 2.5×10^{-5} b. 2.5×10^{-10} (c.) 4.0×10^{-10} d. 4.0×10^{-11}

$$K_a = \frac{x^2}{[HA]} = \frac{(1E-5)^2}{0.25} = \frac{1E-10}{1/4} = 4E-10$$

12. Solution A has a pH of 7, and solution B has a pOH of 9. Which solution has a higher concentration of hydroxide ions?

pH = 5

(a.) Solution A (↑ pH) c. They have the same concentration of hydroxide ions.

b. Solution B d. The concentration of hydroxide ions cannot be determined.

favored = weaker!

$$ClO_2^-(aq) + HC_2H_3O_2(aq) \leftrightarrow HClO(aq) + C_2H_3O_2^-(aq)$$

13. The equilibrium constant for the reaction represented by the equation above is less than 1.0. Which of the following gives the correct relative strength of the acids and bases in the reaction?

	Acids	Bases
a.	$HC_2H_3O_2 > HClO$	$ClO_2^- > C_2H_3O_2^-$
(b.)	$HClO > HC_2H_3O_2$	$C_2H_3O_2^- > ClO_2^-$
c.	$HClO > HC_2H_3O_2$	$ClO_2^- > C_2H_3O_2^-$
d.	$HC_2H_3O_2 > HClO$	$C_2H_3O_2^- > ClO_2^-$