

Chemistry 12 Worksheet on Acids / Bases

Use a separate sheet of paper to calculate and write your answers.

1. Complete the following table.

$[\text{H}_3\text{O}^+]$	$[\text{OH}^-]$	pH	pOH
$(3.75 \times 10^{-3} \text{ M})$	$2.67 \times 10^{-12} \text{ M}$	2.426	11.574
$(2.55 \times 10^{-9} \text{ M})$	$3.92 \times 10^{-6} \text{ M}$	8.593	5.407
$(6.2 \times 10^{-6} \text{ M})$	$1.6 \times 10^{-9} \text{ M}$	5.21	8.79
$1.14 \times 10^{-13} \text{ M}$	$(8.80 \times 10^{-2} \text{ M})$	12.944	1.056
$4.211 \times 10^{-5} \text{ M}$	$(2.375 \times 10^{-10} \text{ M})$	4.3757	9.6243
$6.7 \times 10^{-2} \text{ M}$	$(1.5 \times 10^{-13} \text{ M})$	1.18	12.82
$2.8 \times 10^{-4} \text{ M}$	$3.5 \times 10^{-11} \text{ M}$	(3.55)	10.45
$2 \times 10^{-11} \text{ M}$	$5 \times 10^{-4} \text{ M}$	(10.7)	3.3
$5.8 \times 10^{-6} \text{ M}$	$1.7 \times 10^{-9} \text{ M}$	(5.24)	8.76
$3.5 \times 10^{-4} \text{ M}$	$2.8 \times 10^{-11} \text{ M}$	3.45	(10.55)
$7.2 \times 10^{-13} \text{ M}$	$1.4 \times 10^{-2} \text{ M}$	12.14	(1.86)
$3.2 \times 10^{-8} \text{ M}$	$3.2 \times 10^{-7} \text{ M}$	7.50	(6.50)

2. Write the K_a expression for the dissociation of;

(A) carbonic acid

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]}$$

(B) benzoic acid

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{C}_6\text{H}_5\text{COO}^-]}{[\text{C}_6\text{H}_5\text{COOH}]}$$

(C) formic acid

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{HCOO}^-]}{[\text{HCOOH}]}$$

(D) ammonium ion

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{NH}_3]}{[\text{NH}_4^+]}$$

3. Write the K_b expression and calculate the value of K_b for;

(A) hydrogen carbonate ion (HCO_3^-)

$$K_b = \frac{[\text{OH}^-][\text{H}_2\text{CO}_3]}{[\text{HCO}_3^-]} = \frac{1 \times 10^{-14}}{4.3 \times 10^{-7}} = 2.3 \times 10^{-8}$$

(B) ammonia

$$K_b = \frac{[\text{OH}^-][\text{NH}_4^+]}{[\text{NH}_3]} = \frac{1 \times 10^{-14}}{5.6 \times 10^{-10}} = 1.8 \times 10^{-5}$$

3. Write the K_b expression and calculate the value of K_b for;

(C) carbonate ion (CO_3^{2-})

$$K_b = \frac{[\text{OH}^-][\text{HCO}_3^-]}{[\text{CO}_3^{2-}]} = \frac{1 \times 10^{-14}}{5.6 \times 10^{-11}} = 1.8 \times 10^{-4}$$

(D) hydrogen sulfite ion (HSO_3^-)

$$K_b = \frac{[\text{OH}^-][\text{H}_2\text{SO}_3]}{[\text{HSO}_3^-]} = \frac{1 \times 10^{-14}}{1.5 \times 10^{-2}} = 6.7 \times 10^{-13}$$

4. What is the pH of the following acids?

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|-------------------------|------------|
| (A) 0.0035 M HCl | pH = 2.46 |
| (B) 0.045 M acetic acid | pH = 3.05 |
| (C) 1.25 M benzoic acid | pH = 2.045 |
| (D) 0.75 M nitrous acid | pH = 1.73 |

5. What is the pH of the following?

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|--|-------------|
| (A) 0.75 M ammonia | pH = 11.56 |
| (B) 0.50 M sodium nitrite (NaNO_2) | pH = 8.52 |
| (C) 1.00 M potassium carbonate (K_2CO_3) | pH = 12.126 |
| (D) 2.00 M sodium cyanide (NaCN) | pH = 11.805 |