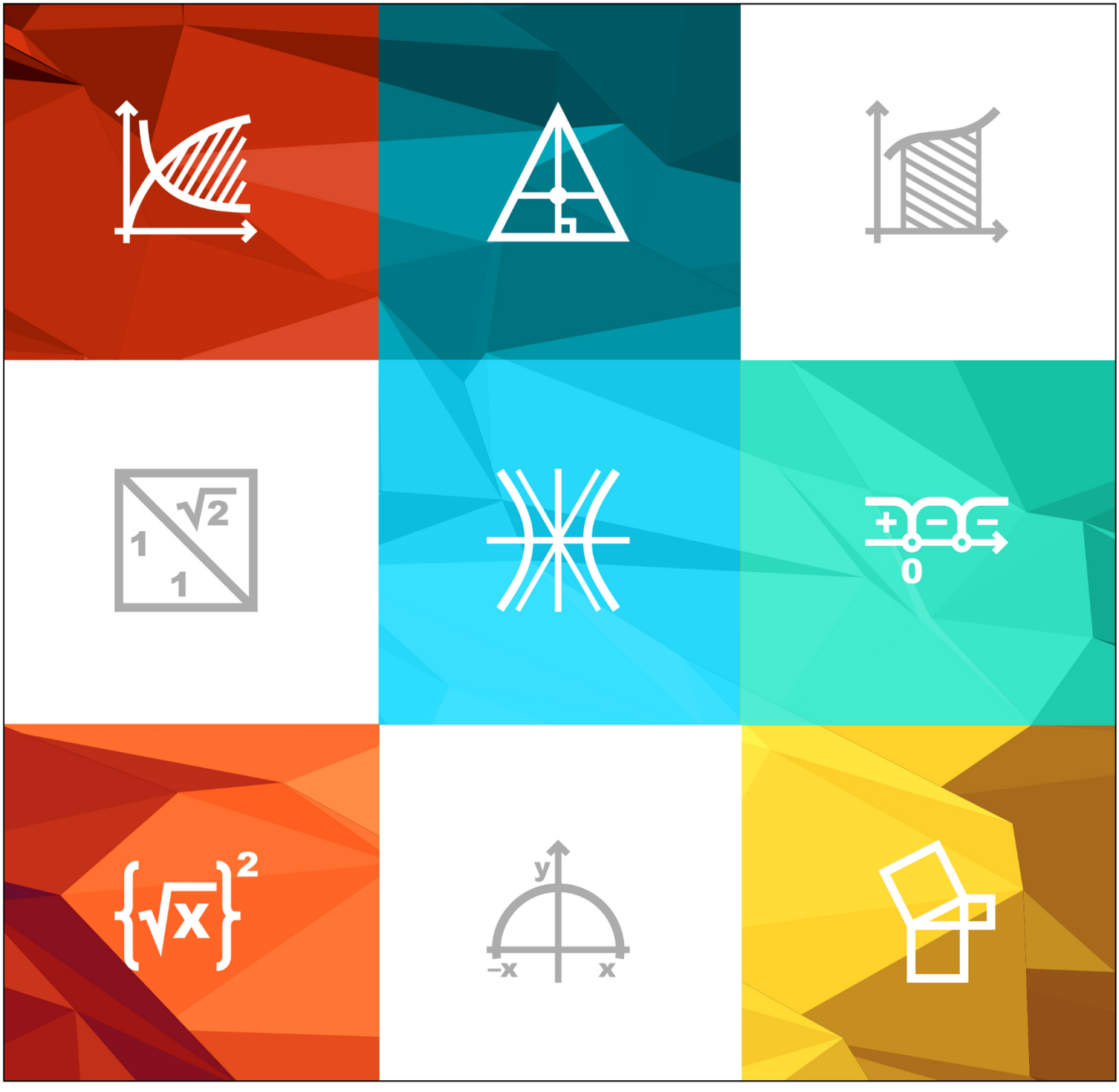
proprep

# Workbook



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# Acids and Bases

## Introduction to Acid and Bases

### Questions

**1)** What is the conjugate base of each of the following acids?
1) HCl 2) $CH_3CH_2COOH$ 3) $NH_4^+$

4) $CH_3OH$ 5) $H_2SO_4$ 6) $HNO_2$

**2)** What is the conjugate acid of each of the following bases?
1) $CO_3^{2-}$ 2) $NH_3$ 3) $ClO_4^-$
4) $SO_4^{2-}$ 5) $OH^-$ 6) $C_2H_3O_2^-$

**3)** Identify the acids and bases and their conjugate acids and bases in the following reactions:

1) $C_5H_5N + H_2O \rightleftharpoons C_5H_5NH^+ + OH^-$

2) $C_6H_5COOH + H_2O \rightleftharpoons C_6H_5COO^- + H_3O^+$

**4)** Identify the acids and bases and their conjugate acids and bases in the following reactions:

1) $C_5H_5N + H_2O \rightleftharpoons C_5H_5NH^+ + OH^-$

2) $C_6H_5COOH + H_2O \rightleftharpoons C_6H_5COO^- + H_3O^+$

## Answer Key

**1)** 1) $Cl^-$ 2) $CH_3CH_2COO^-$ 3) $NH_3$
4) $CH_3O^-$ 5) $HSO_4^-$ 6) $NO_2^-$

**2)** 1) $HCO_3^-$ 2) $NH_4^+$ 3) $HClO_4$

4) $HSO_4^-$ 5) $H_2O$ 6) $HC_2H_3O_2$

**3)** 1) B A CA CB

$$C_5H_5N + H_2O \rightleftharpoons C_5H_5NH^+ + OH^-$$

2) A B CB CA

$$C_6H_5COOH + H_2O \rightleftharpoons C_6H_5COO^- + H_3O^+$$

**4)** 1) A B CB CA

$$H_2PO_4^- + H_2O \rightleftharpoons HPO_4^{2-} + H_3O^+$$

2) B A CA CB

$$C_2H_3O_2^- + H_2O \rightleftharpoons HC_2H_3O_2 + OH^-$$

3) A B CA CB

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

# Strong Acids and Bases

## Questions

**1)** Calculate $[H_3O^+]$ and $[OH^-]$ for the following solutions of strong acids and bases:

a) 0.037 M HCl
b) $2.5*10^{-5}$ M $HNO_3$
c) 0.0045 M KOH

**2)** What is the pH and pOH of the following solutions of strong acids and bases:

a) $2.7*10^{-4}$ M NaOH
b) 0.00522 M $HClO_4$
c) $9.27*10^{-4}$ M $Ca(OH)_2$

**3)** Calculate the pOH, $[H_3O^+]$ and $[OH^-]$ of a sample with:

a) pH = 2.69
b) pH = 9.24

**4)** Calculate the pH of a saturated solution of $Ca(OH)_2$ which contains 1.73 g $Ca(OH)_2$ per 1 L of solution.

**5)** Calculate the pH of a solution obtained by diluting 50 mL of 0.25 M HCl solution to 7 L with water.

## Answer Key

**1)** a) $[H_3O^+] = 0.037$ M, $[OH^-] = 2.7*10^{-13}$ M

b) $[H_3O^+] = 2.5*10^{-5}$ M, $[OH^-] = 4*10^{-10}$ M

c) $[H_3O^+] = 2.2*10^{-12}$ M, $[OH^-] = 0.0045$ M

**2)** a) pH = 10.4, pOH = 3.6

b) pH = 2.28, pOH = 11.72

c) pH = 11.27, pOH = 2.73

**3)** a) pOH = 11.3, $[H_3O^+] = 2.04*10^{-3}$ M, $[OH^-] = 4.9*10^{-12}$ M

b) pOH = 4.76, $[H_3O^+] = 1.74*10^{-5}$ M, $[OH^-] = 5.75*10^{-10}$ M

**4)** pH = 12.66

**5)** pH = 2.75