

1) Designate which of the following is (1) an Arrhenius acid, (2) an Arrhenius base, (3) a Bronsted-Lowry acid, (4) a Bronsted-Lowry base (5) both an Arrhenius acid and a Bronsted-Lowry acid, (6) both an Arrhenius base and a Bronsted-Lowry base, (7) not an acid or a base.

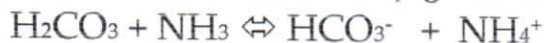
- A) H_2SO_4 5 proton generator/donator
 B) $LiOH$ 6 proton acceptor and OH^- generator
 C) NH_2CH_3 4 proton acceptor / no OH^- generation
 D) CH_3CH_3 7 not a proton donator/acceptor, no OH^- generation

2) Which of the following species is amphoteric? (can be 0, 1 or 2 answers)

- A) CO_3^{2-} B) H_2O C) NH_4^+ D) HPO_4^{2-} E) None of the above

The answer(s) is/are letter(s) B & D

3) Designate which is (1) the acid, (2) the base, (3) the conjugate acid, (4) the conjugate base?



- H_2CO_3 = 1
 NH_3 = 2
 HCO_3^- = 4
 NH_4^+ = 3

4) Based on K_a values, which of the following acids is the STRONGEST?

- A) HF 3.5×10^{-4} D) $HCHO_2$ 1.8×10^{-4}
 B) HCN 4.9×10^{-10} E) $HClO_2$ 1.1×10^{-2}
 C) HNO_2 4.6×10^{-4}

The answer is letter E

5) Which of the following is a polyprotic acid?

- A) HF
 B) H_2SO_4
 C) HCN
 D) CH_4
 E) $HC_2H_3O_2$

The answer is letter B

- 6) Calculate the concentration of OH⁻ in a solution that contains 3.9×10^{-4} M H₃O⁺ at 25°C. Identify the solution as acidic, basic or neutral.

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14} = (3.9 \times 10^{-4} \text{ M}) [\text{OH}^-]$$

$$[\text{OH}^-] = \frac{1.0 \times 10^{-14}}{3.9 \times 10^{-4}} = 2.6 \times 10^{-11}$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] = -\log 3.9 \times 10^{-4} = 3.4 \quad \underline{\text{ACIDIC}}$$

- 7) Calculate the hydronium ion concentration in an aqueous solution with a pH of 9.85 at 25°C.

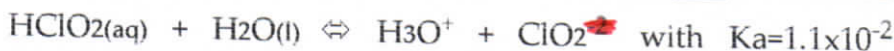
$$\text{pH} = 9.85 \quad [\text{H}_3\text{O}^+] = 10^{-\text{pH}} = 10^{-9.85} = 1.4 \times 10^{-10} \text{ M}$$

- 9) Find pH for a 0.023 M HNO₃ solution. $\text{HNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{NO}_3^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$

$$[\text{H}_3\text{O}^+] = 0.023 \text{ M} \quad -\log [\text{H}_3\text{O}^+] = -\log 0.023 = 1.64 \text{ pH} \quad \text{2 sig figs}$$

$$= 2.3 \times 10^{-2} \text{ M} \quad (2 \text{ sig figs})$$

- 10) Given that the solution contains 0.00115 M HCl and 0.01000 M HClO₂. For the reaction:



Find the pH of the solution.

[HClO ₂]	[H ₃ O ⁺]	[ClO ₂ ⁻]
.01	.00115	0
-x	+x	+x
0.01-x	0.00115+x	x
.004	.00755	.006

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

$$= \frac{(.00115+x)x}{.01-x}$$

$$K_a = 1.1 \times 10^{-2} = \frac{(0.00115+x)x}{.01-x} = \frac{0.00115x + x^2}{.01-x}$$

$$1.1 \times 10^{-2} (.01-x) = .00115x + x^2$$

$$1.1 \times 10^{-4} - 1.1 \times 10^{-2} x = .00115x + x^2$$

$$0 = x^2 + .01215x - 1.1 \times 10^{-4}$$

$$x = \frac{-0.01215 \pm \sqrt{1.48 \times 10^{-4} + 4.4 \times 10^{-4}}}{2} = \frac{-0.01215 + 0.0242}{2} = .006 \quad (\text{the neg. number would give a neg. } x)$$

$$K_a = \frac{(.00755)(.006)}{.004} = 1.1 \times 10^{-2} \quad \checkmark$$

$$[\text{H}_3\text{O}^+] = 0.00755 \quad \text{pH} = -\log 0.00755 = 2.12$$