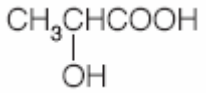
Practice exam questions Chapter 11: Acids and Bases (Paper-saver version)

Question 1 (Bursary 2001 Question 6)

Lactic acid

The major acidic component of soured milk is lactic acid. It is produced by the action of bacteria on lactose in milk.

Lactic acid has the structure: 

For convenience, this can be written as HLac, so the reaction of lactic acid with water would be:

$$HLac + H_2O \rightleftharpoons Lac^- + H_3O^+$$

Calculate the pH of a 0.100 mol L^{-1} solution of lactic acid. A M

$K_a(HLac) = 1.38 \times 10^{-4}$ $\quad pK_a = 3.86$

Question 2 (Bursary 2001 Question 10)

Solutions

Vinegar is a 5% solution of ethanoic acid (CH_3COOH) in water. Ethanoic acid is a weak acid.

a Explain what is meant by the term **weak acid**. A

b List the species (other than water) that are present in an ethanoic acid solution. A

c Explain why a solution of sodium ethanoate is a better electrolyte (conductor of electricity) than an ethanoic acid solution of the same concentration. A M

Soda water

Commercial soda water is made by dissolving carbon dioxide in a sodium hydrogen carbonate solution. Carbon dioxide in solution can be written as H_2CO_3.

$$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$$

H_2CO_3 is a weak acid and reacts with water according to the equation:

$$H_2CO_3(aq) + H_2O(l) \rightleftharpoons HCO_3^-(aq) + H_3O^+(aq)$$

Fresh soda water contains both H_2CO_3 and HCO_3^-. Once the bottle is opened, all the CO_2 gradually escapes.

Discuss why the pH of a bottle of soda water that has been opened for a week is higher than that of a fresh sample. A M E

Question 3 (Bursary 2000 Question 10)

Phosphates in nature and in commercial products
Urine is buffered by the $H_2PO_4^-/HPO_4^{2-}$ conjugate pair.

a Write the expression for K_a for this acid-base conjugate pair. A

The pK_a value for the $H_2PO_4^-/HPO_4^{2-}$ conjugate pair is 7.2.

b Select the species present in higher concentration if the pH in urine is 6.6. A
$H_2PO_4^-$ HPO_4^{2-}
Justify your answer. M E

Cleaning fluids are often bases which hydrolyse greasy materials to soluble products. Aqueous ammonia (NH_3) is one example of such a product. Others are caustic soda (NaOH) and sugar soap (Na_3PO_4).

p$K_a(HPO_4^{2-})$ = 12.2 p$K_a(NH_4^+)$ = 9.2

c Select the stronger base: PO_4^{3-} NH_3 A
Justify your answer. M

d Some cleaning solutions leave a surface residue. Give the formula for the cleaning product named above that would not leave a residue. A
Justify your choice. M