

- Ascorbic acid (Vitamin C) is a monoprotic acid of formula $C_6H_8O_6$. Calculate the pH of a 0.10 M solution of ascorbic acid, given the K_a of ascorbic acid is 8.0×10^{-5} M.

3

Answer:

- Write equations to show what happens to a buffer solution containing equimolar amounts of $C_6H_5CH_2COOH$ and $C_6H_5CH_2COOK$ when:
(a) H_3O^+ is added, (b) OH^- is added.

2

(a)

(b)

- Calculate the pH of a solution that is 0.010 M in benzoic acid, C_6H_5COOH , and 0.010 M in $C_6H_5CO_2Na$. The K_a of benzoic acid is 6.4×10^{-5} M.

4

Answer:

Would this solution make a good buffer system? Give reasons for your answer?

- The gases NO_2 and N_2O_4 are in equilibrium according to the following equation.



In which direction will the reaction move when the following changes are made?

The pressure is increased by decreasing the volume.

The temperature is increased.

2

- Quinine is a natural product that has anti-malarial properties. It was originally extracted for therapeutic use from the bark of the cinchona tree, but is now synthesised by the pharmaceutical industry. Quinine is not very soluble in water and is generally administered as the more soluble hydrochloride salt ($C_{20}H_{24}N_2O_2 \cdot HCl$). The pK_a of this salt is 4.32. What is the pH of a 0.053 M solution of quinine hydrochloride?

Marks
3

Answer:

- Use chemical equations to illustrate how $HPO_4^{2-}/H_2PO_4^-$ can act as a buffer.

2

Marks
6

- Butyric acid, $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$, is found in rancid butter and parmesan cheese. The $\text{p}K_{\text{a}}$ of butyric acid is 4.83.
(a) What is the pH of a 0.10 M water solution of butyric acid?

Answer:

- (b) Calculate the pH of the solution formed when 0.050 mol of NaOH(s) is added to 1.0 L of 0.10 M butyric acid.

Answer:

- (c) Using equations, comment on how the final solution in (b) will respond to additions of small amounts of acid or base in comparison to 1 L of water.

Marks
6

- Lactic acid, $\text{CH}_3\text{CHOHCOOH}$, is produced in the body during normal exercise. It is a monoprotic acid with a $\text{p}K_{\text{a}}$ of 3.86.

(a) What is the pH of a 0.10 M water solution of lactic acid?

Answer:

(b) Calculate the pH of the solution formed when 0.02 mol of $\text{Ca}(\text{OH})_2(\text{s})$ is added to 1.0 L of 0.10 M lactic acid.

Answer:

(c) Using equations, comment on how the final solution in (b) will respond to additions of small amounts (e.g. less than 0.01 mol) of acid or base in comparison to additions of the same amounts of acid or base to 1 L of water.

Marks
2

- Codeine, a cough suppressant extracted from crude opium, is a weak base with a $pK_b = 5.79$. What is the pH of a 0.020 M solution of codeine?

Answer:

3

- A buffer solution is formed with 0.250 M CH_3COOH and 0.350 M CH_3COONa . What is the pH of this buffer solution? (K_a of acetic acid = 1.8×10^{-5} M.)

Answer:

Calculate the pH of the solution formed when 6.3×10^{-2} mol of NaOH is added to 1.0 L of the buffer solution.

Answer:

Marks
6

- Write the balanced chemical equation for the dissolution of solid $\text{Ca}(\text{CH}_3\text{CO}_2)_2$ in water.

What is the pH of a solution that has 158.2 g of $\text{Ca}(\text{CH}_3\text{CO}_2)_2$ dissolved in 1.000 L of water? The pK_a of acetic acid, CH_3COOH , is 4.76.

pH =

Calculate the pH of this solution after the addition of 0.250 mol of HCl gas?

pH =

- Both $\text{HCO}_3^-(\text{aq})$ and $\text{CO}_2(\text{aq})$ are present in human blood. How does their presence ensure that the pH of blood is maintained at ~ 7.2 , even if $\text{H}^+(\text{aq})$ or $\text{OH}^-(\text{aq})$ are produced by processes in the body?

4

How does hyperventilation (very rapid breathing) interfere with this balance? What is the effect?

- The pH value of pure water at 25 °C is 7.00. How, if at all, does that value change when the temperature is changed to 37 °C (a person's body temperature)? Explain.

3

Is pure water at 37 °C acidic, basic or neutral? Circle your choice.

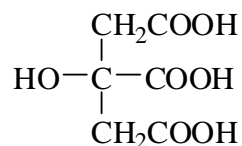
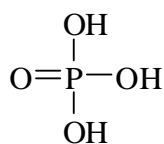
acidic

basic

neutral

Marks
3

- Consider the two triprotic acids, phosphoric acid and citric acid.

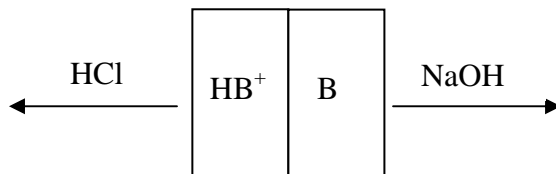


Acid	Formula	K_{a1}	K_{a2}	K_{a3}
phosphoric	H_3PO_4	7.1×10^{-3}	6.3×10^{-8}	4.5×10^{-13}
citric	$\text{C}_6\text{H}_8\text{O}_7$	7.1×10^{-4}	1.7×10^{-5}	6.4×10^{-6}

Explain why $K_{a1} > K_{a2} > K_{a3}$ for both acids.

For phosphoric acid, the K_a values differ by about 5 orders of magnitude while for citric acid there is a much smaller difference. Explain.

- A buffer system with a weak base B and its conjugate acid HB^+ is shown in the diagram below with equal concentrations. Complete the diagram by showing the relative concentrations after the addition of some HCl or $NaOH$.



Write down the balanced net ionic equations for both these reactions.

Calculate the pH of a buffer if it contains 0.200 mol of $NaNO_2$ and 0.300 mol of HNO_2 in 1.00 L of water. The pK_a of HNO_2 is 3.15.

pH =

What is the pH if (a) 0.05 mol of $HCl(g)$ and (b) 0.25 mol of $HCl(g)$ is added?

(a) pH =

(b) pH =

Marks
5

- The concentration of a dissolved gas is related to its partial pressure by $c = kp$. What is the concentration of CO_2 dissolved in blood if the partial pressure of CO_2 in the lungs is 0.053 atm? The k for CO_2 is $0.034 \text{ mol L}^{-1} \text{ atm}^{-1}$.

Answer:

Calculate the pH of blood if all of this CO_2 reacted to give H_2CO_3 .
The K_a of H_2CO_3 is 4.5×10^{-7} .

Answer:

Hyperventilation results in a decrease in the partial pressure of CO_2 in the lungs. What effect will this have on the pH of the blood? Use a chemical equation to illustrate your answer.

The pH of blood is maintained around 7.4 by the $\text{H}_2\text{CO}_3 / \text{HCO}_3^-$ buffer system. Explain how a buffer works, illustrating your answer with chemical equations.