

- 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 $0.034 \text{ mol L}^{-1} \text{ atm}^{-1}$.

Using $c = kp$,

$$c = (0.034 \text{ mol L}^{-1} \text{ atm}^{-1})(0.053 \text{ atm}) = 0.0018 \text{ mol L}^{-1}$$

Answer: **0.0018 mol L⁻¹**

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} .

If $[\text{H}_2\text{CO}_3(\text{aq})] = 0.0018 \text{ mol L}^{-1}$, the pH can be calculated using the reaction table:

	H_2CO_3	H_2O	\rightleftharpoons	H_3O^+	HCO_3^-
initial	0.0018	large		0	0
change	-x	negligible		+x	+x
final	$0.0018 - x$	large		x	x

The equilibrium constant K_a is given by:

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} = \frac{x^2}{0.0018 - x}$$

As $K_a = 4.5 \times 10^{-7}$ and is very small, $0.0018 - x \sim 0.0018$ and hence:

$$x^2 = 0.0018 \times (4.5 \times 10^{-7}) \quad \text{or} \quad x = 2.8 \times 10^{-5} \text{ M} = [\text{H}_3\text{O}^+]$$

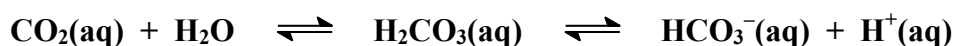
Hence:

$$\text{pH} = -\log_{10} [\text{H}_3\text{O}^+(\text{aq})] = -\log_{10}(2.8 \times 10^{-5}) = 4.54$$

Answer: **4.54**

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.

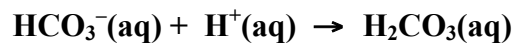
If the CO_2 partial pressure decreases, the equilibrium below will shift to the left. This will decrease $[\text{H}^+(\text{aq})]$ and the pH will increase.



ANSWER CONTINUES ON THE NEXT PAGE

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.

A buffer resists changes in pH. It contains substantial quantities of a weak acid and its conjugate base. In the $\text{H}_2\text{CO}_3/\text{HCO}_3^-$ buffer, added acid is removed by the reaction:



Added base is removed by the reaction:

