Answer on Question #74581, Chemistry / General Chemistry :

1.50 grams of HNO_2 is added to water to obtain a final volume of 700.0 mL. What is the equilibrium concentration of H^+? k_a for HNO_2= 4.6 x 10^{-4}.

Solution.

$$m(HNO_2) = 1.50g$$
$$V = 700.0ml$$
$$M(HNO_2) = 47g/mol$$
$$Ka = 4.6 \cdot 10^{-4}$$

$$\left[H^+\right] - ?$$

Molarity of HNO_2:

$$C(HNO_2) = \frac{m(HNO_2)}{M(HNO_2) \cdot V}$$
$$C(HNO_2) = \frac{1.50g}{0.7l \cdot 47g/mol}$$
$$C(HNO_2) = 0.0456M$$

Ostwald`s dilution law is a relationship between the dissociation constant K_d and the degree of dissociation α of a weak electrolyte:

$$k_a = \frac{\alpha^2}{1-\alpha} \cdot C \approx \alpha^2 \cdot C$$
$$\alpha = \sqrt{\frac{\alpha^2}{C}}$$

The equilibrium concentration of H^+:

$$\left[H^+\right] = \alpha \cdot C = \sqrt{\frac{\alpha^2}{C}} \cdot C = \sqrt{\alpha^2 \cdot C}$$
$$\left[H^+\right] = \sqrt{\left(4.6 \cdot 10^{-4}\right) \cdot 0.0456M}$$
$$\left[H^+\right] = 9.82 \cdot 10^{-5} M$$

Answer: $\left[H^+\right] = 9.82 \cdot 10^{-5} M$ **.**