Chapter 14 − Practice FRQ 3

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1. (a)

$$[\text{H}^+] = 10^{-4.95}$$
$$= 1.12 \cdot 10^{-5} \tag{1}$$

   (b)

$$K_a = \frac{[\text{H}^+][\text{OBr}^-]}{[\text{HOBr}]}$$
$$\left(\frac{2.3 \cdot 10^{-9}}{(1.8 \cdot 10^{-5})^2}\right) = .14[\text{M}] \tag{2}$$

   (c) i.

$$V = \frac{2 \cdot .065 \cdot .146}{.115}$$
$$= .0412[\text{L}] \tag{3}$$

   ii.

$$.0412 \cdot .115 = .004738[\text{mol}]$$
$$\frac{.004738}{.0412 + .065} = .0446[\text{M}]$$
$$K_b = \frac{10^{-14}}{2.3 \cdot 10^{-9}}$$
$$= 4.35 \cdot 10^{-6} \tag{4}$$
$$x = \sqrt{.0446 \cdot 4.35 \cdot 10^{-6}}$$
$$= 4.4 \cdot 10^{-4}$$
$$14 + \log_{10}\left(4.4 \cdot 10^{-4}\right) = 10.65$$
The pH is greater than 7

(d)

$$K_a = \frac{\left[\text{OBr}^-\right]\left[\text{H}^+\right]}{\left[\text{HOBr}\right]} = \frac{\frac{x}{.125} \cdot 5 \cdot 10^{-9}}{\frac{.02}{.125}}$$

$$\frac{2.3}{5} \left(\frac{.02}{\cancel{.125}}\right) = \frac{x}{\cancel{.125}} \tag{5}$$

$$x = .0092 \, [\text{mol}]$$

(e) Because $HBrO_3$ has more molecules, it is greater in size. Due to a larger size, the intermolecular forces are weaker, which makes it dissociates more easily. Because it dissociates more easily, the K_a value is greater, which means it is a stronger acid.