Answer on Question #67128, Chemistry, General Chemistry

A 500ml buffer solution is 0.100M in HNO2HNOX2 and 0.150M in KNO2KNOX2. Determine whether or not the addition of the given amount of each substance exceeds the capacity of the buffer to neutralize it.
250mg NaOH
350mg KOH
1.25g HBr
1.35g HI

Solution:

We have acidic buffer solution, which consists of weak acid – HNO_2 and salt of this acid – KNO_2.

The pH value of buffer solution equals

$pH_1 = pKa + lg \frac{C(KNO2)}{C(HNO2)}$, where pKa = - lg Ka (Ka is dissociation constant of HNO_2; pKa = - lg $5.0 \cdot 10^{-4}$ = 3.3)

For neutralization state the pH value equals 7. It means, that ΔpH = 7-3.3 = 3.7.

We can calculate the buffer capacity value, using formula:

$\beta = \frac{n}{\Delta pH \cdot Vbuffer}$, where n is number of moles of base or acid.

So, for sodium hydroxide NaOH buffer capacity is (n(NaOH) = m/M = 0.25/40 = 0.00625 moles):

$\beta(NaOH) = \frac{0.00625}{3.7 \cdot 0.5} = 0.0034$

For KOH buffer capacity is (n(KOH) = m/M = 0.35/56 = 0.00625 moles):

$\beta(KOH) = \frac{0.00625}{3.7 \cdot 0.5} = 0.0034$

For HBr buffer capacity is (n(HBr) = m/M = 1.25/81 = 0.015 moles):

$\beta(HBr) = \frac{0.015}{3.7 \cdot 0.5} = 0.0081$

For HI buffer capacity is (n(HI) = m/M = 1.35/128 = 0.01 moles):

$\beta(HI) = \frac{0.01}{3.7 \cdot 0.5} = 0.005$

Answer: β(NaOH) = 0.0034; β(KOH) = 0.0034; β(HBr) = 0.0081; β(HI) = 0.005.