

Answer on Question #55712 - Chemistry - Physical Chemistry

Question:

the standard reduction potential for the half cell

$\text{NO}_3^-(\text{aq}) + 2\text{H}^+ + e^- \rightarrow \text{NO}_2(\text{g}) + \text{H}_2\text{O}$ is 0.78V

i) calculate reduction potential in 8M[H⁺]

ii) what will be the reduction potential of the half cell in the neutral solution.

assume all other species to be at unit concentration.

Solution:

i) According to Nernst equation for pH-dependent reaction

$$E(\text{Ox/Red}) = E^0 + \frac{0.059}{n} \lg[H^+]^m + \frac{0.059}{n} \lg \frac{[\text{Ox}]}{[\text{Red}]}$$

So for reaction above $n=1$ (number of electrons), $E^0=0.78$ V, $m=2$ (H^+ coefficient)

$$E(\text{NO}_3^-/\text{NO}_2) = 0.78 + \frac{0.059}{1} \lg[8]^2 + \frac{0.059}{1} \lg \frac{[1]}{[1]} = 0.887 \text{ (V)}$$

ii) For neutral solution (pH=7) concentration of $[\text{H}^+]=10^{-7}$

$$\text{So } E(\text{NO}_3^-/\text{NO}_2) = 0.78 + \frac{0.059}{1} \lg[10^{-7}]^2 + \frac{0.059}{1} \lg \frac{[1]}{[1]} = 0.072 \text{ (V)}$$

Answer: i) 0.887 V; ii) 0.072 V