(18.11) Calculate the critical deposition potential ($E$-$E^o$) for $10^{-12}$ M $^{210}$Bi on a gold cathode (no over-voltage) from the Nernst equation (18.6), where the chemical activity of the reduced state ($Bi^0$) is set to unity.

First the definition of some constants:

$$R := 8.31451 \cdot \frac{joule}{mole \cdot K} \qquad F := 96485.31 \cdot \frac{coul}{mole}$$

then begin by calculating the temperature and setting up the equation for the electrochemical potential:

$$T := (273.15 + 25) \cdot K$$

$$n := 3 \qquad RTnF := \frac{R \cdot T}{n \cdot F} \qquad RTnF = 0.009 \cdot volt$$

The activities of the two species are given as:

$$a_{Bi0} := 1 \qquad a_{Bi3} := 10^{-12}$$

Assume chemical activity = concentration

Then use the equation for electrochemical potential to calculate the critical deposition potential:

$$\Delta E := RTnF \cdot \ln\left(\frac{a_{Bi3}}{a_{Bi0}}\right) \qquad \Delta E = -0.237 \cdot volt$$