10.3 Stoichiometry of Cell Reactions

- In the reaction, $Zn^{2+}_{(aq)} + 2\ e^- \rightarrow Zn_{(s)}$, two moles of electrons are needed to plate one mole of zinc onto a surface.
- Problem: you can't directly measure 2 moles of electrons. It must be done indirectly.
- First, how is charge determined:
  q = It, where q = charge in coulombs
  t = time
  I = current (coulombs per second)
- E.g. What is the charge that passes through a cell in 24 hours if it uses up 300kA of current?
  I = 300kA = 300000 C/s
  t = 24h = 86000 s
  q = It = 300000 C/s x 86000 s = 2.6×10^{10} C

Faraday's Law

- Faraday's Law: the mass of a substance formed or consumed at an electrode is directly related to the charge transferred.
- Faraday Constant: the charge of one mole of electrons; F = 9.65×10^4 C/mol
- Using the constant we can develop a conversion factor converting electric charge to an amount in moles
- $N_{e^-} = It/F$
- E.g. What amount of electrons is transferred in a cell that operates for 1.25 hours at a current of 0.150A?
  t = 1.25h = 4.5×10^3 s

  $N_{e^-} = It/F = (0.150\ C/s \times 4.5 \times 10^3\ s)/ 9.65 \times 10^4\ C/mol = 6.99 \times 10^{-3}$ mol

Half-Cell Calculations

- Since the number of electrons generated at one electrode must be used at the other electrode you only need to calculate the number of electrons flowing at one electrode to know how many are flowing into the other.