Nernst Equation: Electrode Potential Factors

https://gemini.google.com/app/fc175b7cce97e79e

Response: The reduction half-reaction for the given electrode system is:

$$\mathrm{M}^{2+}(\mathrm{aq}) + 2\mathrm{e}^- \rightleftharpoons \mathrm{M}(\mathrm{s})$$

According to the Nernst equation, the electrode potential E at temperature T is given by:

$$E = E^\circ - \frac{RT}{nF} \ln\left(\frac{1}{[\mathrm{M}^{2+}]}\right)$$

where:

- E° is the standard electrode potential.
- R is the universal gas constant.
- T is the absolute temperature.
- n is the number of electrons transferred ($n = 2$).
- F is Faraday's constant.
- $[\mathrm{M}^{2+}]$ is the concentration of the aqueous metal ions.

Analysis of Factors

- **(a) Surface area of M(s):** Electrode potential is an intensive property and does not depend on the surface area or mass of the solid electrode. (Pure solids have an activity of 1).
- **(b) Concentration of $\mathrm{M}^{2+}(\mathrm{aq})$:** As shown in the Nernst equation, changing $[\mathrm{M}^{2+}]$ directly alters the value of E.
- **(c) Temperature:** Temperature T appears directly in the Nernst equation (and affects E°), so E changes with temperature.
- **(d) Volume of $\mathrm{M}^{2+}(\mathrm{aq})$ solution:** Changing the volume without changing concentration has no effect on the electrode potential (an intensive property).

Correct Factors: (b) and **(c)**
