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- The physiological properties of chromium depend on its oxidation state. Consider the half reaction in which Cr(VI) is reduced to Cr(III).

$$CrO_4^{2-}(aq) + 4H_2O(l) + 3e^- \rightarrow Cr(OH)_3(s) + 5OH^-(aq) \qquad E^o = -0.13 \text{ V}$$

Calculate the potential for this half reaction at 25 ^{o}C, where pH = 7.40 and $[CrO_4^{2-}(aq)] = 1.0 \times 10^{-6}$ M.

As pH + pOH = 14.00 and pOH = -log$_{10}$([OH$^-$(aq)]), at pH = 7.40,

pOH = 14.00 – 7.40 = 6.60 = -log$_{10}$([OH$^-$(aq)])

[OH$^-$(aq)] = 10$^{-6.60}$

The reaction quotient for the half-cell reaction is,

$$Q = \frac{[OH^-(aq)]^5}{[CrO_4^{2-}(aq)]} = \frac{(10^{-6.60})^5}{(1.0 \times 10^{-6})} = 1.0 \times 10^{-27}$$

Using the Nernst equation for this three electron process,

$$E = E^o - \frac{RT}{nF} \ln Q = (-0.13) - \frac{8.314 \times (25+273)}{3 \times 96485} \ln(1.0 \times 10^{-27}) = +0.40 \text{ V}$$

Answer: E = **+0.40 V**