DATE: NAME: CLASS:

| CHAPTER 13 | Thought Lab: Assigning Reference Values | BLM 13.1.3 |
|---|---|---|
| HANDOUT | | |

Many scales of measurement have zero values that are arbitrary. For example, on Earth, average sea level is often assigned as the zero of altitude. In this Thought Lab, you will investigate what happens to calculated cell potentials when the reference half-cell is changed.

## Procedure

**1.** Choose the half reaction for $Al^{3+}$ and Al as your reference point and assign a value of 0 V for this half-reaction. To make the standard cell potential for the $Al^{3+}/Al$ half-reaction equal to zero, you would have to add 1.66 V to the accepted standard reduction potential. To adjust all the reduction potentials to the new reference, you add 1.66 V to each value.

| Reduction half-reaction | Accepted $E°$ (V) | Adjusted $E°$(V) [+ 1.66 (V)] |
|---|---|---|
| $F_2(g) + 2e^- \rightarrow 2F^-(aq)$ | +2.87 | |
| $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ | +0.77 | |
| $2H^+(aq) + 2e^- \rightarrow H_2(g)$ | 0.00 | |
| $Al^{3+}(aq) + 3e^- \rightarrow Al(s)$ | −1.66 | |
| $Li^+(aq) + e^- \rightarrow Li(s)$ | −3.04 | |

**2.** Use the given standard reduction potentials to calculate the standard cell potentials for the following redox reactions:

**(a)** $2Li(s) + 2H^+(aq) \rightarrow 2Li^+(aq) + H_2(g)$

**(b)** $2Al(s) + 3F_2(g) \rightarrow 2Al^{3+}(aq) + 6F^-(aq)$

**(c)** $2FeCl_3(aq) + H_2(g) \rightarrow 2FeCl_2(aq) + 2HCl(aq)$

**(d)** $Al(NO_3)_3(aq) + 3Li(s) \rightarrow 3LiNO_3(aq) + Al(s)$

**3.** Repeat your calculations using the new, adjusted reduction potentials.

# Thought Lab: Assigning Reference Values (continued)

## Analysis

**1.** Compare your calculations from Procedure Steps 2 and 3. What effect does changing the zero on the scale of reduction potentials have on:
**(a)** reduction potentials?

**(b)** cell potentials?

**2.** Find the difference between the temperatures at which water boils and freezes on the following scales (assume that a difference is positive, rather than negative):
**(a)** the Celsius temperature scale

**(b)** the Kelvin temperature scale

**3.** What do your answers to Question 2 tell you about these two temperature scales?

**4.** How are temperature scales and reduction potentials similar?

**5.** The zero on a scale of masses is not arbitrary. Why not?