CHEM 1032 – Spring 2023 - Challenge Question 9

Which metal is the best choice for a statue?

You are a scientist who has been asked to help an artist select a metal for a statue. Ideally the metal should be able to withstand potential exposure to acid rain. You construct two experiments that involve dipping metals into solutions. For the first experiment, the solutions contain metal ions. In the second experiment, you decide to dip metals in a solution of HNO_3. The tables below summarize your results.

Trial	Metal	Solution Ion	Observation
1	Mg	Al^{3+}	Mg dissolved
2	Al	Fe^{3+}	Al dissolved

Table 1: Experiment 1 Observations

Trial	Metal	Solution Ion	Observation
3	Al	H^+	Bubbles formed, temperature increased, and Al dissolved
4	Cu	H^+	No change observed
5	Fe	H^+	Fe dissolved

Table 2: Experiment 2 Observations

A. Write half reactions for each metal tested. Briefly justify why you selected an oxidation or a reduction half reaction.
Having trouble? Review questions from Chapter 16: 1, 2, and 16.

B. Using the observations, rank the half reactions in Part A from strongest to weakest potential. Explain your rankings.
Having trouble? Review questions from Chapter 16: 37.

C. Using your half reactions from Part A, write balanced redox reactions for each Trial conducted.
Having trouble? Review questions from Chapter 16: 3.

D. Based on your answers from Part A-C, and using a potential table from your textbook, calculate $E°_{cell}$, $\Delta G°$, and K for each Trial conducted. Assume standard conditions.
Having trouble? Review questions from Chapter 16: 27.

E. Using specifics from your answers in Parts A-D, make an argument for which metal is the **best** choice for the statue and which metal is the **worst** choice. Be sure to thoroughly explain!