What is the Nernst Equation and Cell Potential?

Worksheet

The Nernst equation is E_cell = E (RT/nF) ln Q, which predicts the cell voltage under any conditions. At equilibrium (Q = K), E_cell = 0.

$$E_{cell} = E^{@circ} - @frac{RT}{nF} @ln Q$$

Questions

1. The Nernst constant 0.0592 V applies at

A) 100 K
B) 25 C
C) all temperatures
D) zero voltage

2. If E_cell > 0, the reaction is

A) at equilibrium
B) non-spontaneous
C) spontaneous
D) reversible

3. As Q increases toward K, E_cell

A) increases
B) stays constant
C) decreases
D) becomes negative

4. At equilibrium, what is the relationship between K and E?

A) K = E
B) ln K = nFE/RT
C) K = 1/E
D) no relationship

5. A galvanic cell has E = 0.76 V and at 25C with n = 2, Q = 0.1. Find E_cell.

6. At what value of Q does E_cell = 0 for E = 1.0 V and n = 2?

7. If E = 0.34 V, n = 1, and Q = 10, find E_cell at 25C.

8. Define: What is the Nernst equation?

9. Define: What does Q represent in the Nernst equation?

10. Define: When is E_cell = 0?

Answer Key

1. B) 25 C - 0.0592 is derived from (2.303RT/F) at 25C (298 K).
2. C) spontaneous - Positive E_cell means G < 0, so the reaction is spontaneous.
3. C) decreases - Higher Q in the Nernst equation means ln Q is less negative, so E_cell decreases.
4. B) ln K = nFE/RT - At equilibrium E_cell = 0, so 0 = E (RT/nF) ln K, thus ln K = nFE/RT.
5. E_cell = E (0.0592/n) log Q E_cell = 0.76 (0.0592/2) log(0.1) E_cell = 0.76 (0.0296)(1) E_cell = 0.76 + 0.0296 = 0.790 V
6. E_cell = 0 = E (0.0592/n) log Q (0.0592/2) log Q = 1.0 0.0296 log Q = 1.0 log Q = 33.78 Q = K_eq 610
7. E_cell = 0.34 (0.0592/1) log(10) E_cell = 0.34 0.0592(1) E_cell = 0.34 0.0592 E_cell = 0.281 V
8. E_cell = E (RT/nF) ln Q. It predicts cell potential under non-standard conditions.
9. Q is the reaction quotient; it compares current ion concentrations to equilibrium.
10. When Q = K (equilibrium); the cell produces no net voltage.