[TP] At 25 °C

$E = E° - (0.06/n_e)\ \text{V}\ \log(Q)$

What is the value of E when everything is in standard states?

25% 1. $E = \infty$
25% 2. $E = 0$
25% 3. $E = E°$
25% 4. None of the above

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Lecture 26 CH102 A1 (MWF 9:05 am)

Friday, March 30, 2018

- Complete: Cell voltage versus Q/K: The Nernst equation
- Exploring the Nernst equation
- Concentration cells: Mixing → electric current

Next lecture: Review concentration cells. Begin ch 17: Spontaneous change: How far?

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$E = -(0.06/n_e)\ \text{V}\ \log(Q/K)$

The value of E when $Q = 1$ at 25 °C is

$E(Q = 1) = E° = +(0.06/n_e)\ \text{V}\ \log(K)$

Express the cell voltage for any value of Q in terms of $E°$, that is, in terms of the cell voltage when $Q = 1$.

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$E = -(0.06/n_e)\ \text{V}\ \log(Q/K)$

The value of E when $Q = 1$ at 25 °C is

$E(Q = 1) = E° = +(0.06/n_e)\ \text{V}\ \log(K)$

The cell voltage at 25 °C for any value of Q in terms of the cell voltage when $Q = 1$ is

$E(\text{any } Q) = E° - (0.06/n_e)\ \text{V}\ \log(Q)$

This is called the Nernst equation

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Exploring the Nernst equation

$E(\text{any } Q) = E° - (0.06/n_e)\ \text{V}\ \log(Q)$

$E° = +(\ 0.06/n_e\ )\ \text{V}\ \log(K)$

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[TP] At 25 °C

$E = E° - (\ 0.06/n_e\ )\ \text{V}\ \log(Q)$

What is the value of E when everything is in standard states?

0% 1. $E = \infty$
0% 2. $E = 0$
0% 3. $E = E°$
0% 4. None of the above

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[TP] At 25 °C

$E = E° - (\ 0.06/n_e\ )\ \text{V}\ \log(Q)$

What is the value of E when everything is at equilibrium?

0% 1. $E = \infty$
0% 2. $E = 0$
0% 3. $E = E°$
0% 4. None of the above

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[TP] At 25 °C

$E = E° - (\ 0.06/n_e\ )\ \text{V}\ \log(Q)$

What is the value of E when there are no products present?

0% 1. $E = \infty$
0% 2. $E = 0$
0% 3. $E = E°$
0% 4. None of the above

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[Quiz] At 25 °C

$E = E° - (0.06/n_e)\ \text{V} \log(Q)$

What is the value of E when there are only products present?

25% 1. $E = \infty$
25% 2. $E = 0$
25% 3. $E = E°$
25% 4. None of the above

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[TP] For A + B ⇄ 2 C + D at 25 °C

$E° = (0.06/n_e)\ \text{V} \log(K)$

What is the value of the equilibrium constant for

2 A + 2 B ⇄ 4 C + 2 D?

17% 1. K
17% 2. $2\,K$
17% 3. K^2
17% 4. $K/2$
17% 5. $\sqrt{K}$
17% 6. None of the above

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[TP] For A + B ⇄ 2 C + D at 25 °C

$E° = (0.06/n_e)\ \text{V} \log(K)$

What is the value of n_e for

2 A + 2 B ⇄ 4 C + 2 D?

17% 1. n_e
17% 2. $2\,n_e$
17% 3. n_e^2
17% 4. $n_e/2$
17% 5. $\sqrt{n_e}$
17% 6. None of the above

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[Quiz] For A + B ⇄ 2 C + D at 25 °C

$E° = (0.06/n_e)\ \text{V} \log(K)$

What is the value of $E°$ for

2 A + 2 B ⇄ 4 C + 2 D?

17% 1. $E°$
17% 2. $2\,E°$
17% 3. $(E°)^2$
17% 4. $E°/2$
17% 5. $\sqrt{E°}$
17% 6. None of the above

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[TP] For A + B ⇄ 2 C + D at 25 °C

$E° = (0.06/n_e)\ \text{V} \log(K)$

What is the value of $E°$ when all concentrations are doubled?

17% 1. $E°$
17% 2. $2\ E°$
17% 3. $(E°)^2$
17% 4. $E°/2$
17% 5. $\sqrt{E°}$
17% 6. None of the above

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[Quiz] For A + B ⇄ 2 C + D at 25 °C, if $E = 3.7$ V, $E° = 2.0$ V, and $n_e = 1$, what is the value of E when all concentrations are doubled?

20% 1. $E < 3.7$ V
20% 2. $E > 3.7$ V
20% 3. $(E°)^2$
20% 4. $E°/2$
20% 5. $\sqrt{E°}$

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Concentration cells: Mixing → electric current

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Concentration cells: Mixing → electric current

What happens when ink is dropped into water?

It disperses spontaneously

What happens when salt water is dropped into fresh water?

It disperses spontaneously

Let's see how to harness such spontaneity of mixing …

to generate electricity!

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[TP] What do you expect to be true about the process
$Cl^-(0.0001\ M) \rightarrow Cl^-(1\ M)$?

25% 1. $E > 0$
25% 2. $E = 0$
25% 3. $E < 0$
25% 4. More information needed

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Response Counter

20

[TP] What do you expect to be true about the process
$Cl^-(1\ M) \rightarrow Cl^-(0.0001\ M)$?

1. $E > 0$
2. $E = 0$
3. $E < 0$
4. More information needed

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21

[TP] What is true about the process
$Cl^-(1\ M) \rightarrow Cl^-(0.0001\ M)$?

25% 1. $K > 1$
25% 2. $K = 1$
25% 3. $K < 1$
25% 4. More information needed

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Response Counter

10

22

[TP] What is true about the process
$Cl^-(1\ M) \rightarrow Cl^-(0.0001\ M)$?

1. $E° > 0$
2. $E° = 0$
3. $E° < 0$
4. More information needed

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Response Counter

23

[TP] The process

$Cl^-(1\ M) \rightleftarrows Cl^-(0.0001\ M)$

is spontaneous. The correct cell line notation is …

1. Pt(s) | $Cl^-(0.0001\ M)$ | $Cl_2\,(1\ bar)$ || $Cl^-(1\ M)$ | $Cl_2\,(1\ bar)$ | Pt(s)
2. Pt(s) | $Cl^-(0.0001\ M)$ | $Cl_2\,(1\ bar)$ || $Cl_2\,(1\ bar)$ | $Cl^-(1\ M)$ | Pt(s)
3. Pt(s) | $Cl^-(1\ M)$ | $Cl_2\,(1\ bar)$ || $Cl^-(0.0001\ M)$ | $Cl_2\,(1\ bar)$ | Pt(s)
4. Pt(s) | $Cl^-(1\ M)$ | $Cl_2\,(1\ bar)$ || $Cl_2\,(1\ bar)$ | $Cl^-(0.0001\ M)$ | Pt(s)
5. None of the above

Concentration cell construction

Sketch the construction of a chloride concentration cell.