[TP] Based on the balanced oxidation half-reaction, how many moles of electrons are released when 1 mole of $NO(g)$ is oxidized to $NO_3^-(aq)$?

20% 1. 1
20% 2. 2
20% 3. 3
20% 4. 4
20% 5. 6

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Response Counter 10

Lecture 24 CH102 A2 (MWF 11:15 am)

Wednesday, March 27, 2019

Begin ch16: Electron transfer reactions and electrochemistry
- Electrochemistry in a nutshell
- Balancing redox equations
- Electrochemical cells harness spontaneous electron flow
- Cell line notation

Next lecture: Continue ch16. Cell voltage, E_{cell}, and electrical energy; Calculating standard cell voltage, $E°_{cell}$; Cell voltage versus spontaneity.

For oxidation numbers and balancing redox equations, please work through http://goo.gl/MMEUCs

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Electrochemistry in a nutshell

- Redox processes transfer electrons
- Redox processes evolve spontaneously to equilibrium
- Electron transfer can be harnessed as an electric current

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A long time ago …

… my chemistry teacher (John Endicott) ended a lecture by asking us to balance a chemical equation like the following.

$$O_2(g) + NO(g) \rightarrow H_2O_2(aq) + NO_3^-(aq)$$

I tried by inspection, but could not do it.

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Balancing half-reactions

For oxidation numbers and balancing redox equations, please work through http://goo.gl/MMEUCs

$O_2(g)$ reduced to hydrogen peroxide, $H_2O_2(aq)$

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[TP] Based on the balanced reduction half-reaction, how many moles of electrons are consumed when 1 mole of $O_2(g)$ is reduced to hydrogen peroxide, $H_2O_2(aq)$?

20% 1. 1
20% 2. 2
20% 3. 3
20% 4. 4
20% 5. 6

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Balancing half-reactions

For oxidation numbers and balancing redox equations, please work through http://goo.gl/MMEUCs

$NO(g)$ oxidized to $NO_3^-(aq)$

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[TP] Based on the balanced oxidation half-reaction, how many moles of electrons are released when 1 mole of $NO(g)$ is oxidized to $NO_3^-(aq)$?

20% 1. 1
20% 2. 2
20% 3. 3
20% 4. 4
20% 5. 6

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Balancing redox equations

Combine balanced half-reactions for $O_2(g)$ reduced to hydrogen peroxide and $NO(g)$ oxidized to $NO_3^-(aq)$, to balance the redox equation

$$O_2(g) + NO(g) \rightarrow H_2O_2(aq) + NO_3^-(aq)$$

Balancing redox equations

For oxidation numbers and balancing redox equations, please work through http://goo.gl/MMEUCs.

Do on your own:

$$NO_3^-(aq) + H_2C_2O_4(aq) \rightarrow CO_2(g) + NO(g)$$

Electrochemical cells harness spontaneity

Let's explore competition of Cu and Zn atoms for electrons.

$Cu^{2+}(aq)$ oxidizes $Zn(s)$

Spontaneous flow of electrons from Zn to Cu

$$Cu^{2+}(aq) + 2\,e^- \rightarrow Cu(s)$$

$$Zn(s) \rightarrow Zn^{2+}(aq) + 2\,e^-$$

Harness in an electrochemical cell

$$Zn(s)|\,Zn^{2+}(aq)\,||Cu^{2+}(aq)|\,Cu(s)$$

$Cu^{2+}(aq)$ oxidizes $Zn(s)$ spontaneously

Sketch an electrochemical cell to harness the spontaneity of

$$Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$$

$$Zn(s)|\ Zn^{2+}(aq)\ ||Cu^{2+}(aq)|\ Cu(s)$$

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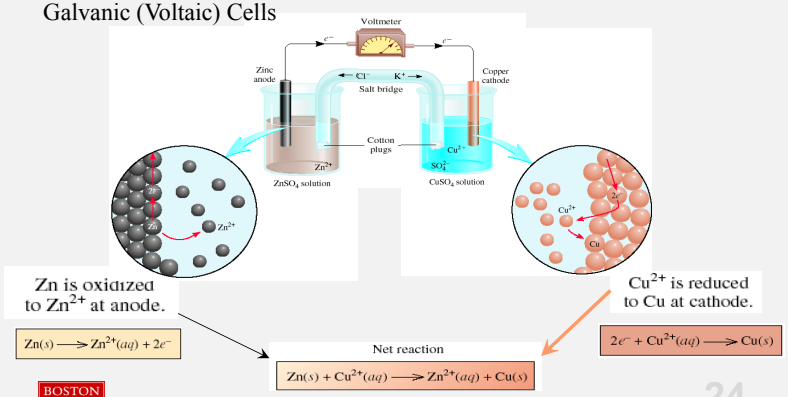
Galvanic (Voltaic) Cells



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Cell line notation (Tro, 4e, p 897)

$$Zn(s)|\ Zn^{2+}(aq)\ ||Cu^{2+}(aq)|\ Cu(s)$$

- Oxidation on left, "||" is salt bridge, reduction on right
- Phases separated by "|", same phases separated by ","
- If no solid, inert electrode (Pt or graphite)
- Left to right order matches flow of electrons

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Cell line notation (Tro, 4e, p 897)

$$Fe(s)|\ Fe^{2+}(aq)\ ||MnO_4^-(aq),\ Mn^{2+}(aq)|\ Pt(s)$$

Write the half reactions ...

$$Fe(s) \rightarrow Fe^{2+}(aq) + 2\,e^-$$

$$MnO_4^-(aq) + 5\,e^- + 8\,H^+(aq) \rightarrow Mn^{2+}(aq) + 4\,H_2O(l)$$

Sketch the cell (on your own).

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