[TP] Identify the correct statement about the redox reaction
$Zn^{2+}(aq) + Cu(s) \rightleftharpoons Cu^{2+}(aq) + Zn(s)$.

17% 1. $Zn^{2+}(aq)$ is the reducing agent because it gains electrons
17% 2. $Cu(s)$ is the reducing agent because it gains electrons
17% 3. $Zn^{2+}(aq)$ is the reducing agent because it loses electrons
17% 4. $Cu(s)$ is the reducing agent because it loses electrons
17% 5. $Zn^{2+}(aq)$ is the reducing agent because it is reduced
17% 6. $Cu(s)$ is the reducing agent because it is reduced

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Lecture 21 CH101 A2 (MWF 11:15 am)

Wednesday, October 24, 2018

For today …
- Balancing oxidation-reduction equations
- Complexation as Lewis acid-base reaction

Begin ch7: Chemical reactions and energy flows
- First law of thermodynamics

Next lecture: System vs. surroundings; Detecting heat; Predicting sign of heat; Detecting work; Amount of heat depends on whether there is work

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Redox reactions: Competition for e⁻

Oxidation-reduction reactions are a competition for electrons

Species that gives up e⁻ →
is oxidized →
It makes possible reduction →
and so is called the reducing agent

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Redox reactions: Competition for e⁻

Oxidation-reduction reactions are a competition for electrons

Species that gives up e⁻ →
is oxidized →
It makes possible reduction →
and so is called the reducing agent

$2\,Ag^{+}(aq) + Cu(s) \rightleftharpoons 2\,Ag(s) + Cu^{2+}(aq)$

Oxidation “half reaction”?

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Redox reactions: Competition for e⁻

Oxidation-reduction reactions are a competition for electrons

Species that accepts e⁻ →
is reduced →
It makes possible oxidation →
and so is called the oxidizing agent

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Redox reactions: Competition for e⁻

Oxidation-reduction reactions are a competition for electrons

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$2\ Ag^+(aq) + Cu(s) \rightleftharpoons 2\ Ag(s) + Cu^{2+}(aq)$

Reduction "half reaction"?

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Getting balanced redox (full) reaction

$$2\ Ag^+(aq) + Cu(s) \rightleftharpoons 2\ Ag(s) + Cu^{2+}(aq)$$

First, get the balanced half-reactions

Then, combine the half-reactions so that the electrons released in the oxidation are exactly consumed in the reduction …

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Lewis alternative definition of acids and bases

Brønsted-Lowry acid is the source of a proton

$$HCl(aq) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$$

Brønsted-Lowry base is destination of proton

$$NH_4^+(aq) + OH^-(aq) \rightarrow H_2O(aq) + NH_3(aq)$$

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Lewis alternative definition of acids and bases

Lewis acid "accepts" a pair of electrons to form a covalent bond

Lewis base has a pair of electrons to form a covalent bond

$$Co^{3+}(aq) + {:}NH_3(aq) \rightarrow [Co({:}NH_3)]^{3+}(aq)$$

Result is acid-base adduct

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Complexation as Lewis acid-base reaction

lone pair source = Lewis base or ligand.

what bonds to lone pair = Lewis acid.

product of acid-base reaction = acid-base adduct.

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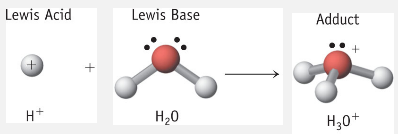
Complexation as Lewis acid-base reaction

lone pair source = Lewis base or ligand.

what bonds to lone pair = Lewis acid.

product of acid-base reaction = *acid-base adduct*.



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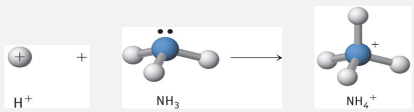

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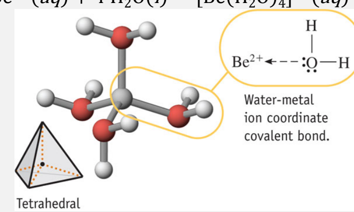
Complexation as Lewis acid-base reaction

lone pair source = Lewis base or ligand.

what bonds to lone pair = Lewis acid.

product of acid-base reaction = *acid-base adduct*.

$$Be^{2+}(aq) + 4\ H_2O(l) \rightarrow [Be(H_2O)_4]^{2+}(aq)$$



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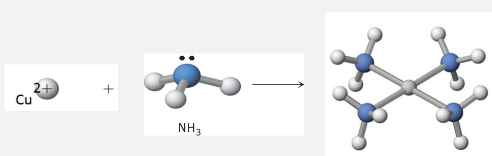
Complexation as Lewis acid-base reaction

lone pair source = Lewis base or ligand.

what bonds to lone pair = Lewis acid.

product of acid-base reaction = *acid-base adduct*.

$$Cu^{2+}(aq) + 4\ NH_3(aq) \rightarrow [Cu(NH_3)_4]^{2+}(aq)$$



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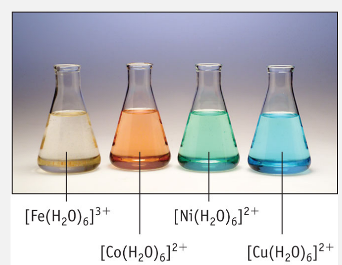
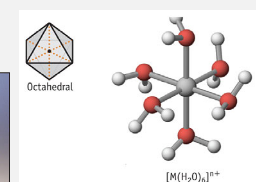
Complexes have characteristic colors





[TP] In the reaction

$$[Cu(:OH_2)_6]^{2+}(aq) + 4\,:Cl^-(aq) + 2\,:NH_3(aq) \rightarrow [Cu(:NH_3)_2:Cl_4]^{2-}(aq) + 6\,:OH_2(l)$$

the number of Lewis acids is …

0% 1. 0
0% 2. 1
0% 3. 2
0% 4. 3
0% 5. 4
0% 6. 5

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Ch 7: Chemical Reactions and Energy Flows

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First law of thermodynamics

Energy, U, is exchanged between system and surroundings as heat, q, and work, w,

$\Delta U = q + w$

Positive values increase energy of system

$\Delta U = q + w$

q = heat flow into the system

w = done on the system

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[TP] In a certain chemical reaction, 10 kJ of heat flow into the system and the system does 21 kJ of work on the surroundings.
This means ΔU = …

0% 1. +31 kJ
0% 2. +21 kJ
0% 3. +11 kJ
0% 4. +10 kJ
0% 5. −10 kJ
0% 6. −11 kJ
0% 7. −21 kJ
0% 8. −31 kJ

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First law of thermodynamics

In a certain chemical reaction, 10 kJ of heat flow into the system and the system does 21 kJ of work on the surroundings. Sketch the energy diagram showing q, w, and ΔU for this reaction. Indicate the initial and final energy by horizontal lines labeled U_i and U_f, respectively.