[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 A1 (MWF 9 am)

Wednesday, October 26, 2016

- Complete: Acid-base reactions
- Oxidation-reduction equations
- Complexation as Lewis acid-base reaction

Next lecture: Begin ch7: Chemical Reactions and Energy Flows

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Acid or base?

Is HCO_3^- and acid or a base?

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Base strength

Weak bases are weak electrolytes: They react only to a small extent with water

$HO{:}H(aq) + {:}NH_2CH_2CH_3(aq) \rightleftarrows H{:}NH_2CH_2CH_3^+(aq) + HO{:}^-(aq)$

Only a little reaction (< 100 % theoretical yield)

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Base strength

Strong bases are strong electrolytes: They react nearly completely with water

Na:OH(s) → Na^+(aq) + $HO:^-$(aq)

Nearly complete reaction (~ 100 % theoretical yield)

$HO:^-$(aq) is a strong proton acceptor

Note that NaOH(s) is a special case: There is no competition for H^+, only hydration of OH^-.

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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^-

Redox reactions are a competition for electrons

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

Oxidation

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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⁻

Redox reactions are a competition for electrons

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

Reduction

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 …

[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
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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

Lewis alternative definition of acids and bases

Brønsted-Lowry acid is the source if a proton

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

Brønsted-Lowry base accepts a proton

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

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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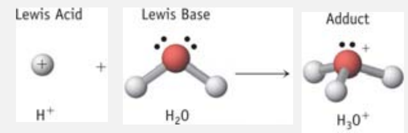
Complexation as Lewis acid-base reaction

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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Complexation as Lewis acid-base reaction

lone pair source = Lewis base or ligand.

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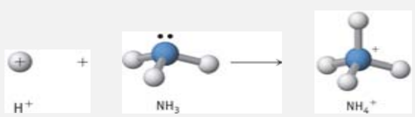

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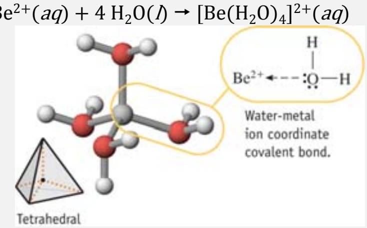
Complexation as Lewis acid-base reaction

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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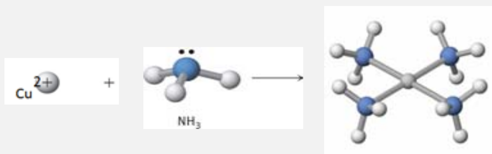
Complexation as Lewis acid-base reaction

lone pair source = Lewis base or ligand.

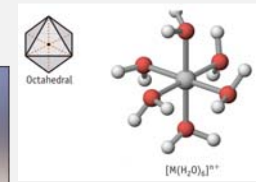
what bonds to lone pair = Lewis acid.

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

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



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 …

17% 1. 0
17% 2. 1
17% 3. 2
17% 4. 3
17% 5. 4
17% 6. 5

