

FUNDAMENTALS OF CHEMISTRY 1A (CHEM1001) - June 2009

2009-J-2

- calcium bromide
 KHCO_3
 potassium permanganate
 iron(III) nitrate

- X
 Y
 X

- $1s^2 2s^2 2p^6$
 $1s^2 2s^2 2p^6 3s^2 3p^5$

2009-J-3

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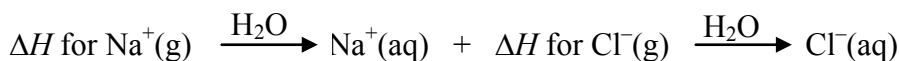
$\begin{array}{c} \text{H}-\ddot{\text{N}}-\text{H} \\ \\ \text{H} \end{array}$	tetrahedral	trigonal pyramidal
$\begin{array}{c} \text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:} \diagdown \quad \diagup \text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{S}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:} \diagup \quad \diagdown \text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:} \end{array}$	octahedral	octahedral
$\left[\begin{array}{c} \text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:} \diagdown \quad \diagup \text{:}\ddot{\text{F}}\text{:} \\ \text{:}\ddot{\text{B}}\text{:} \\ \text{:}\ddot{\text{F}}\text{:} \end{array} \right]^{-}$	tetrahedral	tetrahedral
$\text{:}\ddot{\text{O}}\text{:}=\text{C}=\text{O}\text{:}$	linear	linear
$\begin{array}{c} \text{:}\ddot{\text{Cl}}\text{:} \\ \text{:}\ddot{\text{Cl}}\text{:} \diagdown \quad \diagup \text{:}\ddot{\text{I}}\text{:} \\ \text{:}\ddot{\text{Cl}}\text{:} \end{array}$	trigonal bipyramidal	T-shaped

2009-J-4

- Dissolve the manganese chloride in water.
 $\text{MnCl}_2(\text{s}) \rightarrow \text{Mn}^{2+}(\text{aq}) + 2\text{Cl}^{-}(\text{aq})$
Add a solution of sodium carbonate. Manganese carbonate will precipitate.
 $\text{Mn}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{MnCO}_3(\text{s})$
Filter off and wash the precipitate and then dissolve it in dilute sulfuric acid.
 $\text{MnCO}_3(\text{s}) + 2\text{H}^{+}(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
Evaporate the solution to give manganese sulfate.
 $\text{Mn}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{MnSO}_4(\text{s})$
- Both are ionic compounds with strong electrostatic forces between the oppositely charged particles. The energy required to overcome these attractions is called the lattice enthalpy. When the ions dissolve in water strong bonds are formed between the ions and the polar water molecules. The energy released in this process is called the solvation enthalpy. If the solvation enthalpy exceeds the lattice enthalpy the compound will be soluble. OR

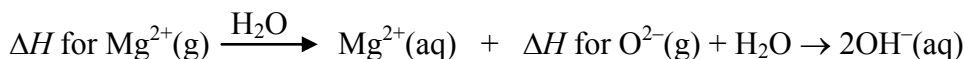
Sodium chloride is soluble because the magnitude of:

ΔH for $\text{NaCl}(\text{s}) \rightarrow \text{Na}^{+}(\text{g}) + \text{Cl}^{-}(\text{g})$ is less than the magnitude of



Magnesium oxide is insoluble because the magnitude of:

ΔH for $\text{MgO}(\text{s}) \rightarrow \text{Mg}^{2+}(\text{g}) + \text{O}^{2-}(\text{g})$ is greater than the magnitude of



2009-J-5

- $\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow \text{Pb}^{2+}(\text{aq}) + 2\text{NO}_3^{-}(\text{aq})$ \longrightarrow
 $\text{Pb}^{2+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightarrow \text{PbI}_2(\text{s})$ H_2O
4.61 g
0.100 M

2009-J-6

- $1 \times 10^{15} \text{ s}^{-1}$ 400 kJ mol^{-1} (300 nm is 1 significant figure)
- Pb_3O_4

2009-J-7

- $1.9 \times 10^2 \text{ L}$
- $2.7 \times 10^{-5} \text{ M}$

2009-J-8

- $4\text{CH}_2=\text{CHCN} + 2\text{H}_2\text{O} \rightarrow 2\text{NC}(\text{CH}_2)_4\text{CN} + \text{O}_2$
- 60.5 kg

2009-J-9

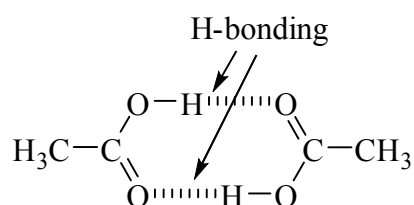
- $\text{WO}_3(\text{s}) + 3\text{H}_2(\text{g}) \rightarrow \text{W}(\text{s}) + 3\text{H}_2\text{O}(\text{g})$
 $K_p = p^3(\text{H}_2\text{O}) / p^3(\text{H}_2)$
 $K_p = K_c$
 $p(\text{CO}) = 0.264 \text{ atm}$ $p(\text{CO}_2) = 0.714 \text{ atm}$

2009-J-10

- $-1007 \text{ kJ mol}^{-1}$
Reaction is spontaneous as $\Delta G < 0$.
- 78.9 kJ mol^{-1} ($\Delta H = -78.9 \text{ kJ mol}^{-1}$)

2009-J-11

- 1.9 J
-



- 0.025

2009-J-12

- Water. It has much stronger intermolecular forces (H-bonds) than acetone (dispersion and dipole-dipole forces).
- The major intermolecular forces in HCl, HBr and HI are dispersion forces. The heavier the halogen, the more electrons it has, the more polarisable its electron cloud and the stronger the dispersion forces. Therefore melting points increase $\text{HCl} < \text{HBr} < \text{HI}$. F is a very small and very electronegative atom. The H-F bond is therefore highly polarised and H-bonds form. These are much stronger than dispersion forces and so HF has an anomalously high m.p. As seen by the experimental order given, this is enough to raise its m.p. above that of HBr, but not above that of HI.
- The C-H bond in CHCl_3 is quite polarised due to the electron-withdrawing effect of the Cl atoms. The polar water molecules can interact better with the polar CHCl_3 molecules than with the non-polar CCl_4 molecules so CHCl_3 is more soluble.