**CHEM1109 (Life Sciences Course) - November 2010**

**2010-N-2**

- $-813.4$ kJ mol$^{-1}$
- The Second Law of Thermodynamics states that the entropy of the Universe increases for a spontaneous process.

$$\Delta S_{\text{univ}} = \Delta S_{\text{surr}} + \Delta S_{\text{sys}} \qquad \text{where } \Delta S_{\text{surr}} = \frac{-\Delta H_{\text{sys}}}{T}$$

$$\Rightarrow \quad \Delta S_{\text{univ}} = \frac{-\Delta H_{\text{sys}}}{T} + \Delta S_{\text{sys}}$$

$$\Rightarrow \quad T\Delta S_{\text{univ}} = -\Delta H_{\text{sys}} + T\Delta S_{\text{sys}} = -\Delta G$$

$\Delta S_{\text{univ}} > 0$ for spontaneous reaction and hence $\Delta G < 0$ for spontaneous reaction.

**2010-N-3**

- 1.80 g L$^{-1}$

  decreases

  no change

  No. The number of gas molecules per unit volume is the same for both gases under the same conditions of temperature and pressure. The MW of $CO_2$ is 44, that of air about 28.8 ($0.2 \times 32 + 0.8 \times 28$), so $CO_2$ is always more dense than air.

**2010-N-4**

- 2.25

  $\Delta G$ is negative. $K > 1$, so reaction is spontaneous.

  $\Delta S$ is positive. There are 2 mol of gaseous products *versus* 1 mol of gaseous reactants.

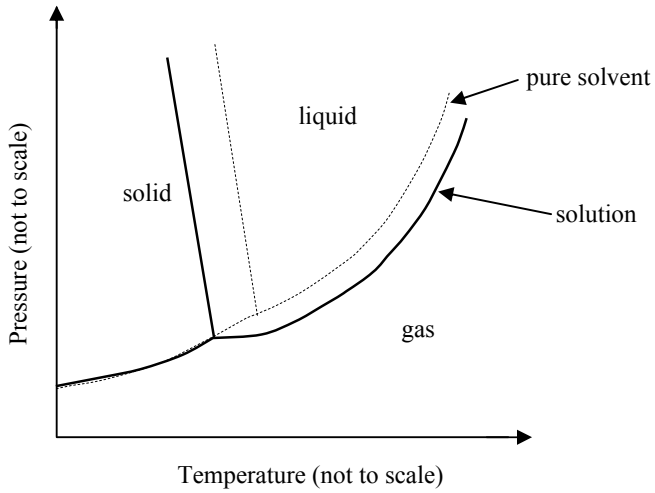
  Perform the reaction in a calorimeter to determine whether heat is gained or lost during the reaction.

  OR

  Increase the temperature and observe whether the equilibrium shifts to the right ($\Delta H > 0$) or to the left ($\Delta H < 0$).

**2010-N-5**

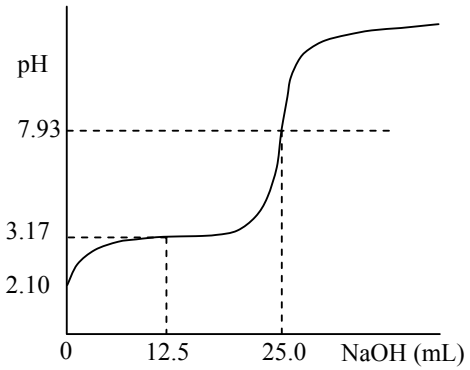
- The presence of solute particles lowers the vapour pressure of the solution compared to that of the pure solvent. This results in a lowering of the freezing point and raising of the boiling point as shown in the phase diagram.




- $1.7 \times 10^{-4}$ g mol$^{-1}$

**2010-N-6**

- (i) 2.10 (2.09 if approximation used) (ii) 3.17 (iii) 7.93 (iv) 12.30




**2010-N-7**

- The $K_{sp}$ of $Fe(OH)_3$ is so low, that even at pH 7.4 there are sufficient $OH^-$ ions present to precipitate the $Fe^{3+}$ ions as $Fe(OH)_3$. To avoid precipitation and to allow a higher concentration of $Fe^{3+}$ to be circulated, $Fe^{3+}$ is complexed by *transferrin* in the bloodstream and iron is stored within *ferritin* within the cell.

**2010-N-8**

- $1.4 \times 10^{-5}$ M

  $1.7 \times 10^{-5}$ M

  5.45 (5.44 if done more exactly)

**2010-N-9**

- $^{18}$Ne has too many protons relative to neutrons within the nucleus. Therefore electrostatic repulsion between the protons destabilises the nucleus.

  Positron emission: $^{18}_{10}\text{Ne} \rightarrow {}^{18}_{9}\text{F} + {}^{0}_{+1}\text{e}$

  Electron capture: $^{18}_{10}\text{Ne} + {}^{0}_{-1}\text{e} \rightarrow {}^{18}_{9}\text{F}$

  1.665 s

  67.18 s

**2010-N-10**

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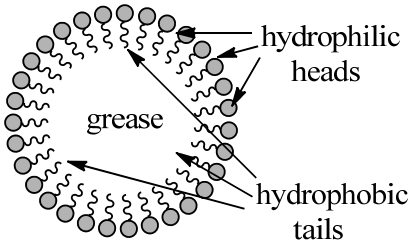



When dissolved in water, sodium stearate gives stearate ions which act as surfactant molecules. The have hydrophobic non-polar tails and ionically charged hydrophilic polar heads. This leads to formation of a stable, spherical micelle structure in which the grease molecules are contained within a monolayer of stearate ions with their heads pointing outwards.

- An acid whose anion is a weaker oxidising agent than $H_3O^+$.

**2010-N-11**

- $3Cu^{2+}(aq) + 2Cr(s) \rightarrow 3Cu(s) + 2Cr^{3+}(aq)$

  $Cr(s) \mid Cr^{3+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$

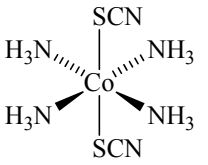
  copper

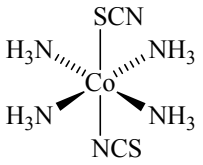
  1.03 V

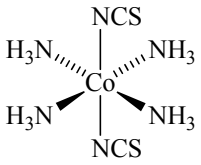
  598 kJ

**2010-N-12**

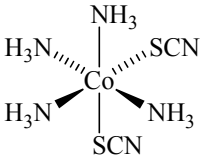
- tetraamminedithiocyanatocobalt(III) chloride

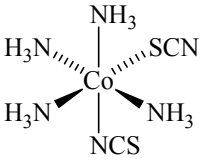


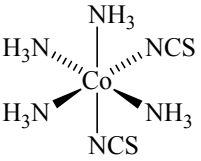




*trans*-isomers




*cis*-isomers

2 thiocyanato ligands

1 thiocyanato ligand &
1 isothiocyanato ligand

2 isothiocyanato ligands

N–H bonds are covalent in $NH_3$. These bonds are relatively short, strong and highly directional.

Co–:$NH_3$ coordination bonds are due to the donation of the lone pair of electrons on N to the $Co^{3+}$. These bonds are weaker, longer and less directional than covalent bonds.

$[Co(NH_3)_4(SCN)_2]^+$ and $Cl^-$ are ionically bonded in the solid state due to coulombic attraction between the oppositely charged ions. These bonds are strong but not directional.

**2010-N-13**

- Rate = $k[H_2SeO_3][I^-]^3[H^+]^2$

  $k = 5.00 \times 10^5\ L^5\ mol^{-5}\ s^{-1}$

  visible spectroscopy - $I_3^-$ is coloured, $I^-$ is not.