Unit 1 Day 1 Activity Jan 15, 2013 (1)

1. Iso-Propanol
- Colorless
- Liquid
- not very viscous
- Evaporates slower!

$CH_3CHOHCH_3$

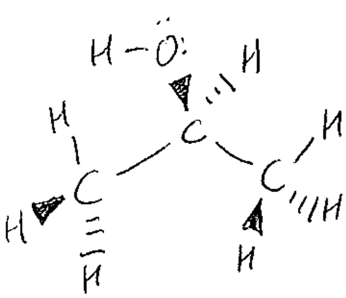
- IMFs: Dispersion Forces
  Dipole-Dipole
  Hydrogen Bonding
- Higher boiling point than acetone
- Higher surface tension than acetone
- More viscous than acetone
- Lower vapor pressure than acetone

Acetone
- colorless
- Liquid
- not very viscous
- Evaporates faster!

CH_3COCH_3

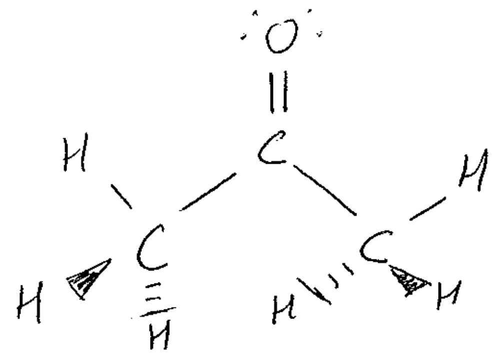
- IMFs: Dispersion Forces
  Dipole-Dipole
- Lower Boiling point than isopropanol
- Lower surface tension than isopropanol
- Less viscous than isopropanol
- Higher vapor pressure than isopropanol

2. Iso-Propanol



OR

Acetone



OR

3. Isopropanol
- All carbon's are tetrahedral

Acetone
- central carbon is trigonal planar
- The remaining two carbons are tetrahedral.

4. Iso-propanol - polar   Acetone - polar

5. • The central carbon of isopropanol has a tetrahedral molecular structure with dissimilar groups attached (CH_3, CH_3, H and OH). The dipole moments therefore do not cancel completely, leaving an overall net dipole moment for the molecule. NOT symmetric = polar.
   • In a similar way, the central carbon of acetone has a trigonal planar molecular structure with dissimilar groups attached (CH_3, CH_3, $\overset{O}{\|}$). The dipole moments do not cancel, leaving a net dipole moment for the molecule. NOT symmetric = polar.

6. Iso-propanol (IMFs) - Dispersion, Dipole-dipole, Hydrogen-bonding
   Acetone (IMFs) - Dispersion, Dipole-dipole
   * Predict higher boiling point here!

7. Iso-propanol because it's IMFs are stronger than those of acetone (H-bonding stronger than dipole-dipole).

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8. A substance in the gas phase generally has a higher enthalpy. The gas particles "feel" fewer intermolecular attractions than liquid particles. Therefore, gas particles tend to be higher in overall energy/enthalpy. Attractive forces lower energy/enthalpy for liquid particles

9. $\Delta H^\circ_{vap} = H_{gas} - H_{liquid}$ because H_{gas} is generally greater than H_{liquid}, ΔH°_{vap} is generally positive (+). (aka Endothermic)!

10. ΔH°_{vap} for isopropanol should be greater than that of acetone because iso-propanol liquid particles have greater attractive forces which lower the H_{liquid}. A smaller H_{liquid} will result in a ΔH_{vap} which is larger in magnitude ($\Delta H^\circ_{vap} = H_{gas} - H_{liquid}$). It takes more energy to break apart the liquid with hydrogen bonding.

11. In general, substances in a gas phase have more possible microstates (arrangements) than substances in a liquid phase. Therefore, substances in a gas phase tend to have greater absolute entropy values. ③

12. $\Delta S^\circ_{vap} = S_{gas} - S_{liquid}$ because S_{gas} is greater than S_{liquid} in general, then ΔS°_{vap} should be ~~positive~~ (+). (Increasing Entropy)

13. The values of ΔS°_{vap} for these two liquids are likely to be about the same because S_{gas} is always greater than S_{liquid} regardless of the IMFs / nature of the substance. ΔS°_{vap} pertains more to the nature of liquids and gasses in general rather than the specific IMFs.
- Deviations from this may occur with substances containing very high IMF (like H_2O).

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14. $\Delta G = \Delta H - T\Delta S$

15. The sign of ΔG indicates wether a certain physical change will occur (or can occur without additional energy given) at a given temperature. $+\Delta G$ = does not occur } - Non-spontaneous
$-\Delta G$ = does occur } - Spontaneous

16. For some reactions, changing temperature can change the sign of ΔG.

17. When $\Delta G = 0$ the products and reactants have the same free energy and the process is in equilibrium. This happens at phase changes.

18. $\Delta G^\circ_{vap} = \Delta H^\circ_{vap} - T\Delta S^\circ_{vap} = 0$? ΔH°_{vap} and ΔS°_{vap} are positive so $T_{boiling}$ is calculated as positive which is reasonable on the absolute Kelvin scale. So yes, there is a T at which $\Delta G^\circ_{vap} = 0$

$$\Delta H^\circ_{vap} = T\Delta S^\circ_{vap}$$

$$\frac{\Delta H^\circ_{vap}}{\Delta S^\circ_{vap}} = T_{boiling}$$

Since ΔS°_{vap} is about the same for both substances, but ΔH°_{vap} is higher for iso-propanol, we can predict that $T_{boiling}$ for iso-propanol will be higher.

$$T_b \text{ (isopropanol)} > T_b \text{ (acetone)}$$

$$\frac{\Delta H^\circ_{vap}}{\Delta S^\circ_{vap}} \text{ (isopropanol)} > \frac{\Delta H^\circ_{vap}}{\Delta S^\circ_{vap}} \text{ (acetone)}$$

This can be predicted through our analysis of IMFs from questions (6) and (7) as well.