The number of dispersion forces is related to solubility in a nonpolar solvent
C_2H_6, CH_4, C_3H_8

Lowest Solubility

CH_4
C_2H_6
C_3H_8

Highest Solubility

CH_4 - only has LF as IMF, and least amount of London Forces (lowest number of protons and electrons) of the three particles
- forms relatively least amount of attractions to the nonpolar solvent
- since solubility is based on amount of IMF, with greater solubility occurring with greater attractions between solute and solvent particles, methane will have the lowest solubility

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CH_4 - only has LF as IMF, and least amount of London Forces (lowest number of protons and electrons) among these 3 particles
- forms relatively least amount of attractions to the nonpolar solvent
- since solubility is based on amount of IMF, with greater solubility occurring with greater attractions between solute and solvent particles, methane will have the lowest solubility

C_3H_8 – only has LF as IMF, and has the greatest amount of LF (highest number of electrons and protons) among these 3 particles
- forms relatively the greatest amount of attractions with the nonpolar solvent
- since solubility is based on amount of IMF, with greater solubility occurring with greater attractions between solute and solvent particles, propane will have the highest solubility

The number of dispersion forces is related to solubility in a nonpolar solvent
C_2H_6, CH_4, C_3H_8

Lowest Solubility

CH_4
C_2H_6
C_3H_8

Highest Solubility

CH_4 - only has LF as IMF, and least amount of London Forces (lowest number of protons and electrons) among these 3 particles
- forms relatively least amount of attractions to the nonpolar solvent
- since solubility is based on amount of IMF, with greater solubility occurring with greater attractions between solute and solvent particles, methane will have the lowest solubility

C_3H_8 – only has LF as IMF, and has the greatest amount of LF (highest number of electrons and protons) among these 3 particles
- forms relatively the greatest amount of attractions with the nonpolar solvent
- since solubility is based on amount of IMF, with greater solubility occurring with greater attractions between solute and solvent particles, propane will have the highest solubility

C_3H_8 – has more LF than methane, but less LF than propane
- forms more attractions with the nonpolar solvent than methane, but less than propane
- since solubility is based on amount of IMF, ethane will have a greater solubility than methane and a lower solubility then propane

The net polarity of a molecule is related to it solubility in a polar compound.
CH_3Br, CH_3F, CH_3Cl

Lowest Solubility

CH_3Br
CH_3Cl
CH_3F

Highest Solubility

- the greater the net dipole, the stronger the dipole-dipole attraction that can occur between two polar molecules
- all three molecules have the same shape, with fluorine being the most EN and Br the least
- therefore, CH_3F has the overall greatest net polarity of the three molecules, this means that is would form the strongest attractions to the polar solvent, giving it the greatest solubility

The net polarity of a molecule is related to it solubility in a polar compound.
CH_3Br, CH_3F, CH_3Cl

Lowest Solubility

CH_3Br
CH_3Cl
CH_3F

Highest Solubility

- the greater the net dipole, the stronger the dipole-dipole attraction that can occur between two polar molecules
- all three molecules have the same shape, with fluorine being the most EN and Br the least
- therefore, CH_3F has the overall greatest net polarity of the three molecules, this means that is would form the strongest attractions to the polar solvent, giving it the greatest solubility

- CH_3Br has the overall lowest net polarity of the three molecules, this means that is would form the weakest attractions to the polar solvent, giving it the lowest solubility

The net polarity of a molecule is related to it solubility in a polar compound.
CH_3Br, CH_3F, CH_3Cl

Lowest Solubility

CH_3Br
CH_3Cl
CH_3F

Highest Solubility

- the greater the net dipole, the stronger the dipole-dipole attraction that can occur between two polar molecules
- all three molecules have the same shape, with fluorine being the most EN and Br the least
- therefore, CH_3F has the overall greatest net polarity of the three molecules, this means that is would form the strongest attractions to the polar solvent, giving it the greatest solubility
- CH_3Br has the overall lowest net polarity of the three molecules, this means that is would form the weakest attractions to the polar solvent, giving it the lowest solubility

- CH_3Cl has the overall net polarity lower than CH_3F but greater than CH_3Br:
  - this means that is would form the weaker attractions to the polar solvent than CH_3F, but greater attractions to the polar solvent than CH_3Br,
  - therefore, its solubility would place it in the middle of the three molecules

The number of hydrogen bonds formed is related to solubility in a polar solvent.
$CH_3CH_2OCH_2CH_3$, $HOCH_2CH_2CH_2CH_2OH$, $CH_3COOCOCH_3$

Lowest Solubility

$CH_3CH_2OCH_2CH_3$
$CH_3COOCOCH_3$
$HOCH_2CH_2CH_2CH_2OH$

Highest Solubility

- for a molecule to form a hydrogen bond, it must have a hydrogen atom bonded to a nitrogen, oxygen, or fluorine
- for a molecule to receive a hydrogen bond it has to contain an oxygen, nitrogen, or fluorine with a lone pair of electrons
- if a molecule can just receive a hydrogen bond (has a N/ O/ F), it is called a **one-way hydrogen bond**
- if a molecule can both form a hydrogen bond (has a H bonded to N / O / F) and can receive a hydrogen bond (has a N / O / F) than it is called a **two-way hydrogen bond**

The number of hydrogen bonds formed is related to solubility in a polar solvent.
$CH_3CH_2OCH_2CH_3$, $HOCH_2CH_2CH_2CH_2OH$, $CH_3COOCOCH_3$

Lowest Solubility

$CH_3CH_2OCH_2CH_3$
$CH_3COOCOCH_3$
$HOCH_2CH_2CH_2CH_2OH$

Highest Solubility

$HOCH_2CH_2CH_2CH_2OH$
- this molecule has a H bonded to an O so it can form a HB and because it contains an O it can also receive HB : therefore a two-way HB can form between it and a polar solvent
- has two spots that can for HB, therefore, it will form the strongest attractions with a polar solvent; particularly a polar solvent that can also form and receive HB
- as a result it will have the highest solubility

The number of hydrogen bonds formed is related to solubility in a polar solvent.
$CH_3CH_2OCH_2CH_3$, $HOCH_2CH_2CH_2CH_2OH$, $CH_3COOCOCH_3$

Lowest Solubility

$CH_3CH_2OCH_2CH_3$
$CH_3COOCOCH_3$
$HOCH_2CH_2CH_2CH_2OH$

Highest Solubility

$HOCH_2CH_2CH_2CH_2OH$
- this molecule has a H bonded to an O so it can form HB and because it contains an O it can also receive HB : therefore a two-way HB can form between it and the solvent
- has two spots that can for HB, therefore, it will form the strongest attractions with a polar solvent; particularly a polar solvent that can also form and receive HB
- as a result it will have the highest solubility

$CH_3COOCOCH_3$ and $CH_3CH_2OCH_2CH_3$
- both molecules contain oxygen atom(s) so they can receive HB, but neither have H bonded to a O so they cannot for HB
- this means their solubility will be lower than the first molecule as they will only have a one-way HB
- because $CH_3COOCOCH_3$ contains more O atoms than $CH_3CH_2OCH_2CH_3$, the first molecule will have more possibilities for a one-way HB, resulting in it forming greater attractions to the polar solvent

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in **polar** and nonpolar solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

C_4H_{10}
C_4H_9OH
NaCl

Highest Solubility

- a polar molecule has a slightly positive and a slightly negative end
- when a dipole-dipole attraction forms, the δ+ve end of one molecule is attracted to the δ-ve of another
- the greater the overall polarities of the molecule, the greater the attraction between the δ+ve and δ-ve ends of the adjacent molecules

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in **polar** and nonpolar solvents
C_4H_{10}, NaCl, C_4H_9OH

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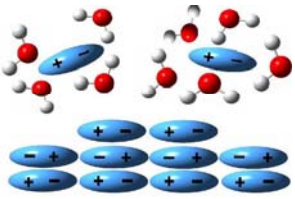
C_4H_9OH
NaCl

Highest Solubility



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- when a dipole-dipole attraction forms, the δ+ve end of one molecule is attracted to the δ-ve of another
- the greater the overall polarities of the molecule, the greater the attraction between the δ+ve and δ-ve ends of the adjacent molecules

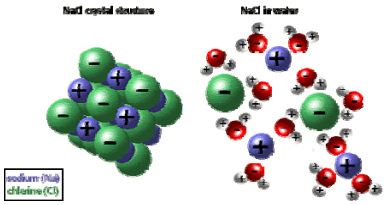
- unlike polar molecules that are partial charges, and ionic compound consists of full charges
- these full charges can establish a stronger electrostatic attraction between the ions of the ionic compound, and the δ+ve and δ-ve ends of the polar molecule

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in **polar** and nonpolar solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

C_4H_{10}
C_4H_9OH
NaCl

Highest Solubility



Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in **polar** and nonpolar solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

C_4H_{10}
C_4H_9OH
NaCl

Highest Solubility

C_4H_{10}
- this is a nonpolar molecule, only capable fo forming weak LF with the polar solvent
- the polar solvent however will form LF and DD attractions with itself
- therefore, the polar solvent will be more attracted to itself than to the nonpolar solute C_4H_{10}
- due to the weak attractions, C_4H_{10} will have really low solubility in the polar solvent

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in **polar** and nonpolar solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

C_4H_{10}
C_4H_9OH
NaCl

Highest Solubility

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- this is a nonpolar molecule, only capable fo forming weak LF with the polar solvent
- the polar solvent however will form LF and DD attractions with itself
- therefore, the polar solvent will be more attracted to itself than to the nonpolar solute C_4H_{10}
- due to the weak attractions, C_4H_{10} will have really low solubility in the polar solvent

NaCl
- this is an ionic compound, containing full charges
- Strong electrostatic attractions will form bewteen the polar solvent and the ions in the ionic compound
- due to these strong attractions between the full ions and the partial charges in the polar solvent, NaCl will have the highest solubility of the three molecules

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in **polar** and nonpolar solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

C_4H_{10}

C_4H_9OH

NaCl

Highest Solubility

C_4H_{10}
- this is a nonpolar molecule, only capable fo forming weak LF with the polar solvent
- the polar solvent however will form LF and DD attractions with itself
- therefore, the polar solvent will be more attracted to itself than to the nonpolar solute C_4H_{10}
- due to the weak attractions, C_4H_{10} will have really low solubility in the polar solvent

NaCl
- this is an ionic compond, containing full charges
- Strong electrostatic attractions will form bewteen the polar solvent and the ions in the ionic compound
- due to these strong attractions between the full ions and the partial charges in the polar solvent, NaCl will have the highest solubility of the three molecules

C_4H_9OH
- this is an polar molecule capable of forming LF and DD attractions with the polar solvent
- as a result C_4H_9OH has a stronger attraction than C_4H_{10} to the polar solvent, but a weaker attraction than the NaCl
- the weaker attractions between C_4H_9OH and the polar solvent is due to them both containing partial charges compared to the full charges in the NaCl

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in polar and **nonpolar** solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

NaCl

C_4H_9OH

C_4H_{10}

Highest Solubility

- A nonpolar solvent can only form weak LF with a potential solute

NaCl
- has high electrostatic attractions between its anions and cations,
- only has weak attractions with the nonpolar solvent
- since NaCl is more attracted to itself than to the nonpolar solvent, it has a very low solubility in a nonpolar solvent

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in polar and **nonpolar** solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

NaCl

C_4H_9OH

C_4H_{10}

Highest Solubility

- A nonpolar solvent can only form weak LF with a potential solute

NaCl
- has high electrostatic attractions between its anions and cations,
- only has weak attractions with the nonpolar solvent
- since NaCl is more attracted to itself than to the nonpolar solvent, it has a very low solubility in a nonpolar solvent

C_4H_9OH
- this is a polar molecule capable of forming LF, DD, and HB attractions with other C_4H_9OH molecules
- only has weak attractions with the nonpolar solvent
- therefore, it is more attracted to itself than to the nonpolar solvent, it has a very low solubility in a nonpolar solvent
- since it consists of partial charges, its attractions to itself are less than NaCl, so it will have a high solubility in the nonpolar solvent than NaCl

Ionic solutes, polar solutes, and nonpolar solvents have different solubility's in polar and **nonpolar** solvents
C_4H_{10}, NaCl, C_4H_9OH

Lowest Solubility

NaCl

C_4H_9OH

C_4H_{10}

Highest Solubility

- A nonpolar solvent can only form weak LF with a potential solute

NaCl
- has high electrostatic attractions between its anions and cations,
- only has weak attractions with the nonpolar solvent
- since NaCl is more attracted to itself than to the nonpolar solvent, it has a very low solubility in a nonpolar solvent

C_4H_9OH
- this is a polar molecule capable of forming LF, DD, and HB attractions with other C_4H_9OH molecules
- only has weak attractions with the nonpolar solvent
- therefore, it is more attracted to itself than to the nonpolar solvent, it has a very low solubility in a nonpolar solvent
- since it consists of partial charges, its attractions to itself are less than NaCl, so it will have a high solubility in the nonpolar solvent than NaCl

C_4H_{10}
- this is a nonpolar molecule, so it can only form LF with itself
- it will form LF with the nonpolar solvent
- since there are equivalent attractions between C_4H_{10} and the nonpolar solvent, it will have the highest solubility

Solutes that contain both polar and nonpolar parts are soluble in both **polar** and nonpolar solvents.
CH_3OH, C_3H_7OH, $C_5H_{11}OH$

Lowest Solubility

$C_5H_{11}OH$
C_3H_7OH
CH_3OH

Highest Solubility

- a molecule with both a polar and nonpolar portion can be soluble in both a polar and nonpolar solvent
- if the nonpolar region of the molecule is large enough, it can interfer with the dipole-dipole attractions that will form between the polar part of the solute and the polar solvent
- if the nonpolar region of the molecule is large enough, it can overcome the attractions between the polar solute particles, and increasing the degree of the LF between the solute and the solvent

Solutes that contain both polar and nonpolar parts are soluble in both **polar** and nonpolar solvents.
CH_3OH, C_3H_7OH, $C_5H_{11}OH$

Lowest Solubility

$C_5H_{11}OH$
C_3H_7OH
CH_3OH

Highest Solubility

CH_3OH
- this is a polar molecule without a nonpolar region, capable of forming LF, DD, and two-way HB with a polar solvent
- these strong IMF between CH_3OH and the polar solvent results in it having the highest solubility out of the three molecules

$C_5H_{11}OH$
- although this molecule can form LF, DD, and HB with a polar solvent, it has the largest nonpolar region
- this results in $C_5H_{11}OH$ having the greatest interference in the formation of DD, and potential HB, with the polar solvent as the long CH-chain will only form weak LF with the polar solvent
- Therefore, $C_5H_{11}OH$ will have the weakest attractions with the polar solvent and thus the lowest solubility

Solutes that contain both polar and nonpolar parts are soluble in both **polar** and nonpolar solvents.
CH_3OH, C_3H_7OH, $C_5H_{11}OH$

Lowest Solubility

$C_5H_{11}OH$
C_3H_7OH
CH_3OH

Highest Solubility

CH_3OH
- this is a polar molecule without a nonpolar region, capable of forming LF, DD, and two-way HB with a polar solvent
- these strong IMF between CH_3OH and the polar solvent results in it having the highest solubility out of the three molecules

$C_5H_{11}OH$
- although this molecule can form LF, DD, and HB with a polar solvent, it has the largest nonpolar region
- this results in $C_5H_{11}OH$ having the greatest interference in the formation of DD, and potential HB, with the polar solvent as the long CH-chain will only form weak LF with the polar solvent
- Therefore, $C_5H_{11}OH$ will have the weakest attractions with the polar solvent and thus the lowest solubility

C_3H_7OH
- has a longer nonpolar region than CH_3OH, but a shorter nonpolar region than $C_5H_{11}OH$
- C_3H_7OH nonpolar region will prevent the formation of DD, and possibly HB, between itself and the polar solvent less than $C_5H_{11}OH$ but more than CH_3OH
- this results in C_3H_7OH having a solbility in a polar solvent greater than $C_5H_{11}OH$ but less than CH_3OH

Solutes that contain both polar and nonpolar parts are soluble in both polar and **nonpolar** solvents.
CH_3OH, C_3H_7OH, $C_5H_{11}OH$

Lowest Solubility

CH_3OH
C_3H_7OH
$C_5H_{11}OH$

Highest Solubility

- the larger the nonpolar region in a molecule with both a polar end and a nonpolar end, the greater the LF that can occur between the nonpolar end of the molecule and a nonpolar solvent

CH_3OH
- this is a polar molecule, forming LF, DD, and HB with itself
- CH_3OH will only form weak LF with the nonpolar solvent
- since CH_3OH is more attracted to itself than to the nonpolar solvent, it will have the lowest solubility in the nonpolar solvent out of the three molecules

Solutes that contain both polar and nonpolar parts are soluble in both polar and **nonpolar** solvents.

CH_3OH, C_3H_7OH, $C_5H_{11}OH$

Lowest Solubility

CH_3OH
C_3H_7OH
$C_5H_{11}OH$

Highest Solubility

CH_3OH
- this is a polar molecule, forming LF, DD, and HB with itself
- CH_3OH will only form weak LF with the nonpolar solvent
- since CH_3OH is more attracted to itself than to the nonpolar solvent, it will have the lowest solubility in the nonpolar solvent out of the three molecules

$C_5H_{11}OH$
- this molecule, the largest with a long nonpolar has the strongest LF attraction with the nonpolar solvent out of the three molecules
- due to the long nonpolar region interfering with the DD and HB attractions between $C_5H_{11}OH$ molecules, it will have the lowest polar attractions out of the three molecules
- these two factors results in $C_5H_{11}OH$ having the strongest attraction to the nonpolar solvent out of the three molecules and therefore the highest solubility

Solutes that contain both polar and nonpolar parts are soluble in both polar and **nonpolar** solvents.

CH_3OH, C_3H_7OH, $C_5H_{11}OH$

Lowest Solubility

CH_3OH
C_3H_7OH
$C_5H_{11}OH$

Highest Solubility

CH_3OH
- this is a polar molecule, forming LF, DD, and HB with itself
- CH_3OH will only form weak LF with the nonpolar solvent
- since CH_3OH is more attracted to itself than to the nonpolar solvent, it will have the lowest solubility in the nonpolar solvent out of the three molecules

$C_5H_{11}OH$
- this molecule, the largest with a long nonpolar has the strongest LF attraction with the nonpolar solvent out of the three molecules
- due to the long nonpolar region interfering with the DD and HB attractions between $C_5H_{11}OH$ molecules, it will have the lowest polar attractions out of the three molecules
- these two factors results in $C_5H_{11}OH$ having the strongest attraction to the nonpolar solvent out of the three molecules and therefore the highest solubility

C_3H_7OH
- has a longer nonpolar region than CH_3OH, but a shorter nonpolar region than $C_5H_{11}OH$
- C_3H_7OH nonpolar region will prevent the formation of DD, and possibly HB, between itself less than $C_5H_{11}OH$ and the LF attractions between the nonpolar solvent and the nonpolar region of C_3H_7OH will be less than between $C_5H_{11}OH$ and the nonpolar solvent
- this results in C_3H_7OH having a solubility in a nonpolar solvent greater than CH_3OH but less than $C_5H_{11}OH$