Compare the strength of IMFs present in three liquids. The liquids are in separate containers.

A. $CH_3CH_2NH_2$ (liquid) B. CH_3CH_2F (liquid)

C. CH_3CH_2OH (liquid)

Draw two 3D Lewis Structures of each compound near enough to have electrostatic attractions

Identify the $\delta+$ and $\delta-$ atoms

Identify the location of the IMFs by using a dashed or dotted line

Identify the type of IMFs present in each liquid.

Which sample of liquid of each compound has the higher boiling point?

Intermolecular Forces and Model Kit Activity

In-class activity

If you and your buddy have a model kit, talk to your neighboring group having the other model kit.

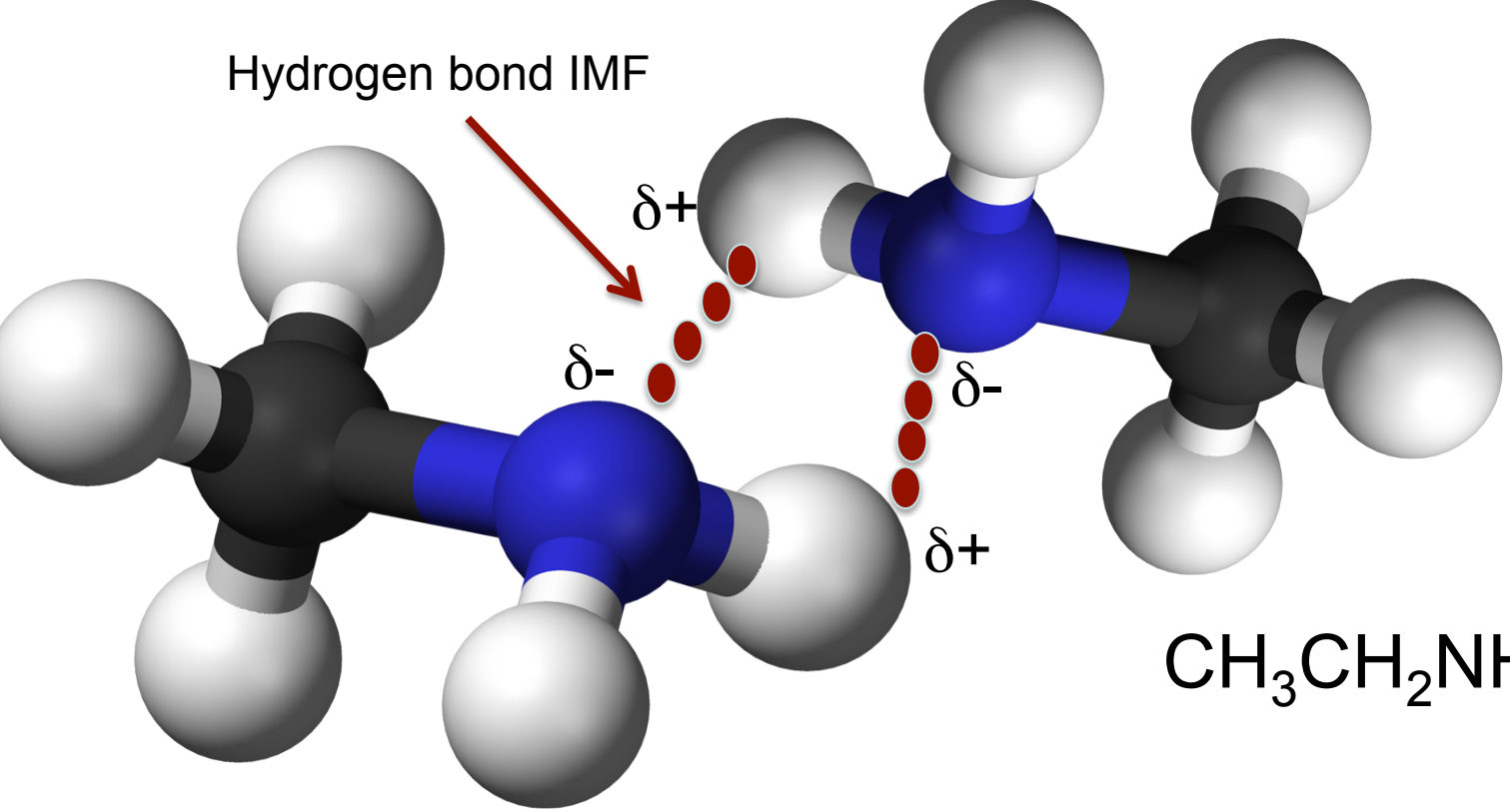
Part A. Each group builds one $CH_3CH_2NH_2$ model.

Use your Table of Electronegativity Values of the Elements to determine which atom(s) has/have a partial positive charge ($\delta+$) and which atom(s) has/have a partial negative charge ($\delta+$). Determine the ΔEN between the atoms.

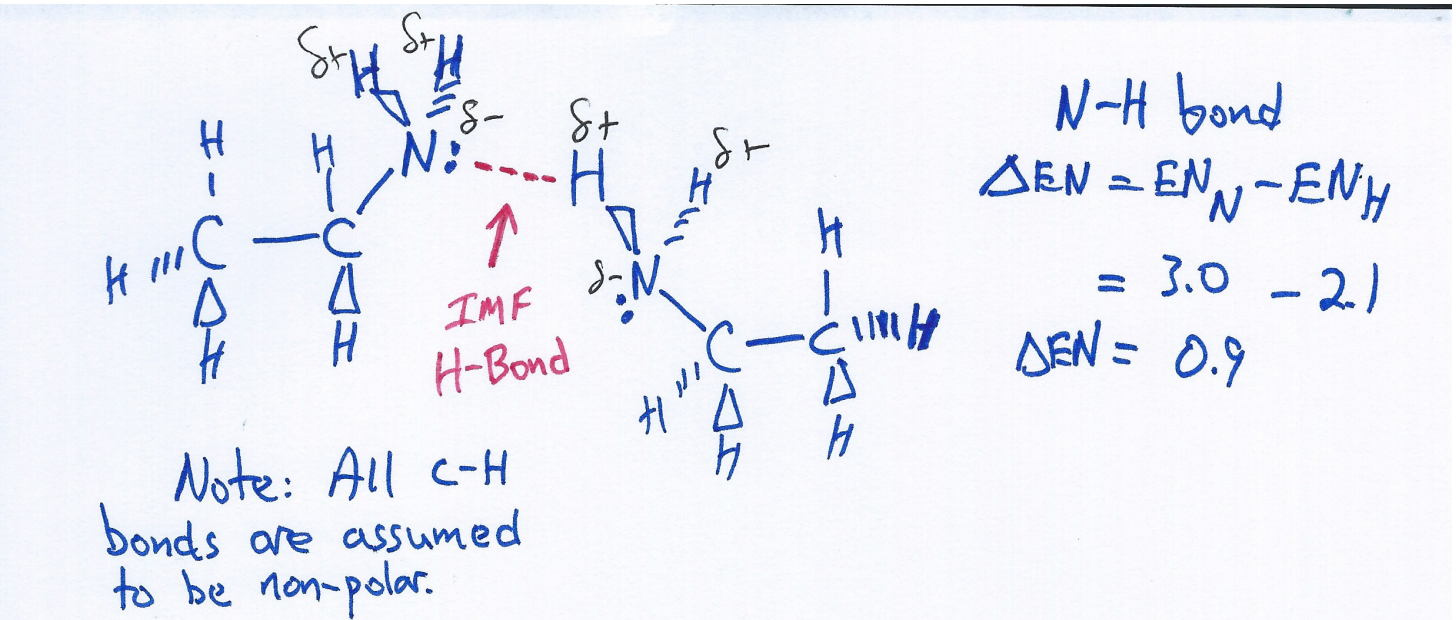
Bring the two models closed together. Use the correct rubber band to connect the two $CH_3CH_2NH_2$ models by the primary IMF at the correct atom locations. How many possible different arrangements are there?

Identify the IMF. Classify the strength of the IMF as weak, medium, or strong.

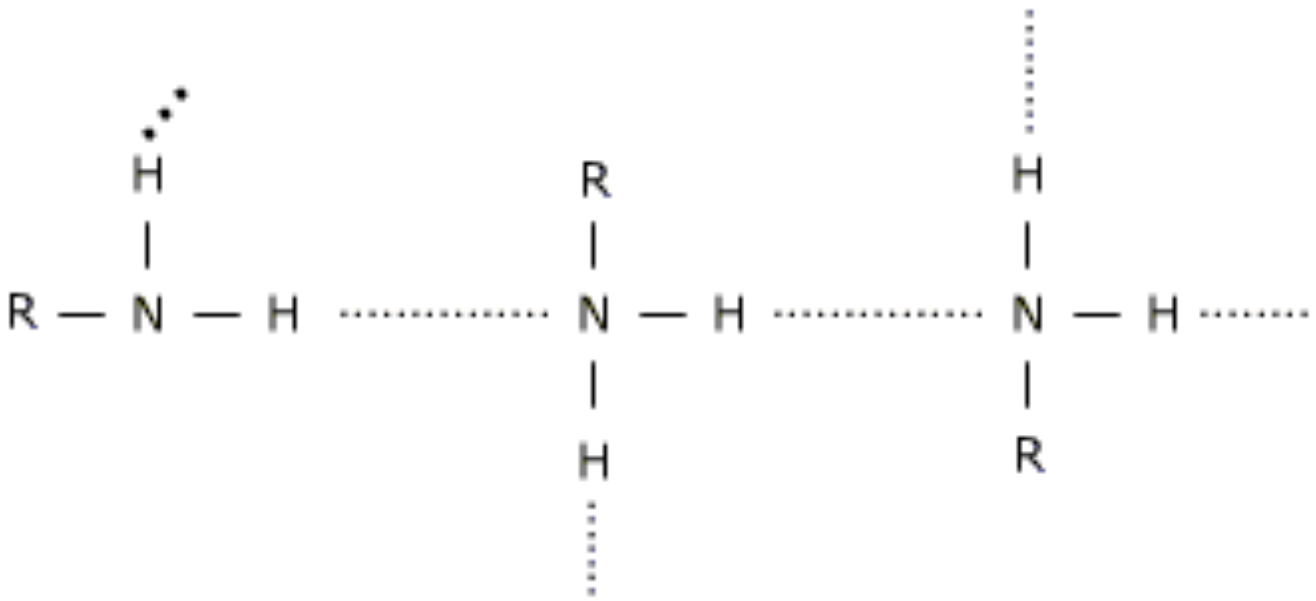
Sketch two 3D Lewis structures representing the two models and use a dashed line to show the correct location of the IMF.



$CH_3CH_2NH_2$ (liquid)



Atom	EN
H	2.1
C	2.5
N	3.0
O	3.5
F	4.0


H
R
N
H
R
N
H
H
N
H
H
R

Intermolecular Forces and Model Kit Activity

In-class activity

Part B Talk to your neighboring group having the other model kit.

Each group builds one CH_3CH_2F model.

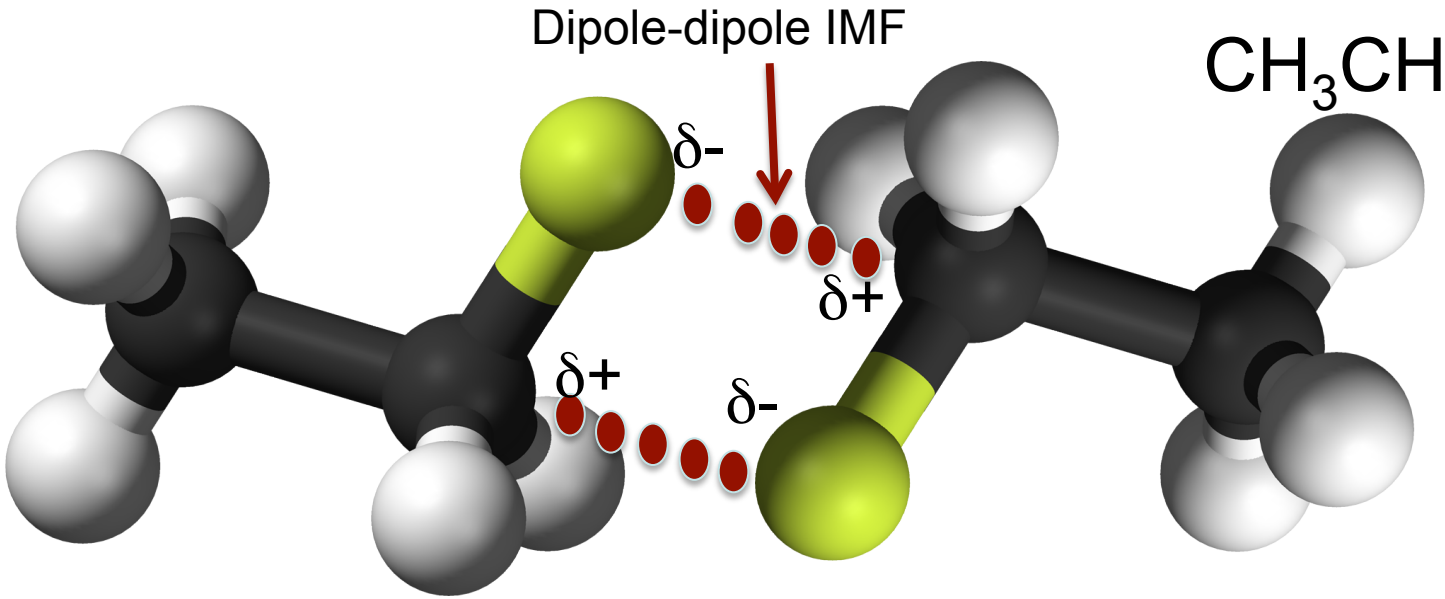
Use your Table of Electronegativity Values of the Elements to determine which atom(s) has/have a partial positive charge ($\delta+$) and which atom(s) has/have a partial negative charge ($\delta+$). Determine the ΔEN between the atoms.

Bring the two models closed together. Use the correct rubber band to connect the two CH_3CH_2F models by the primary IMF at the correct atom locations. How many possible different arrangements are there?

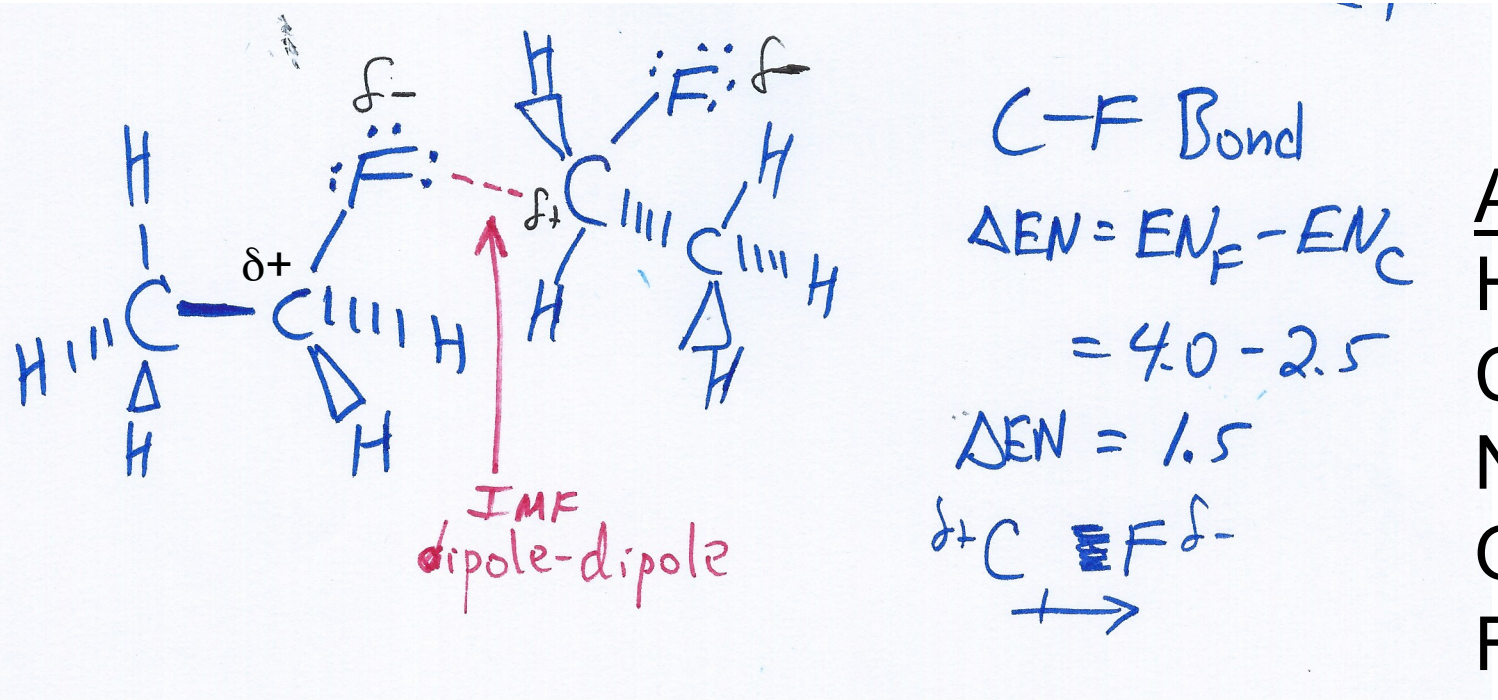
Identify the IMF. Classify the strength of the IMF as weak, medium, or strong.

Compare the IMF between these two models and the IMF between the two $CH_3CH_2NH_2$ models. Which is stronger? Explain.

Sketch two 3D Lewis structures representing the two models and use a dashed line to show the correct location of the IMF.



CH_3CH_2F (liquid)



Atom	EN
H	2.1
C	2.5
N	3.0
O	3.5
F	4.0

Intermolecular Forces and Model Kit Activity

In-class activity

Part B Talk to your neighboring group having the other model kit.

Each group builds one CH_3CH_2OH model.

Use your Table of Electronegativity Values of the Elements to determine which atom(s) has/have a partial positive charge ($\delta+$) and which atom(s) has/have a partial negative charge ($\delta+$). Determine the ΔEN between the atoms.

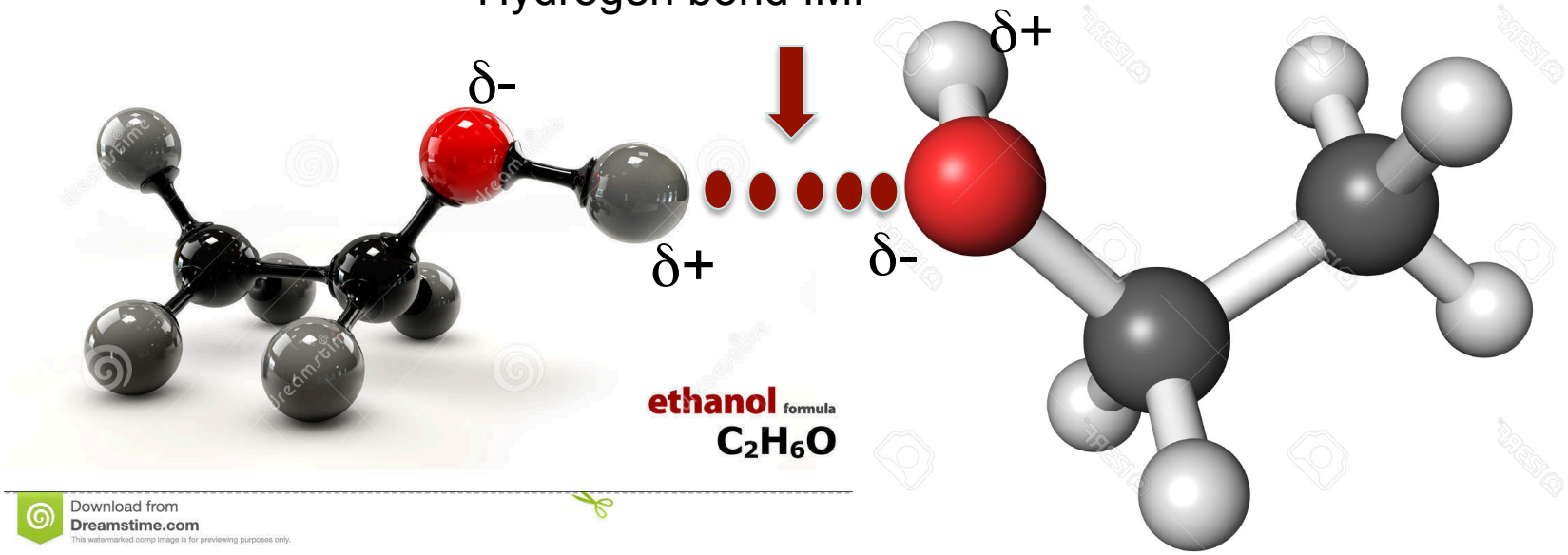
Bring the two models closed together. Use the correct rubber band to connect the two CH_3CH_2OH models by the primary IMF at the correct atom locations. How many possible different arrangements are there?

Identify the IMF. Classify the strength of the IMF as weak, medium, or strong.

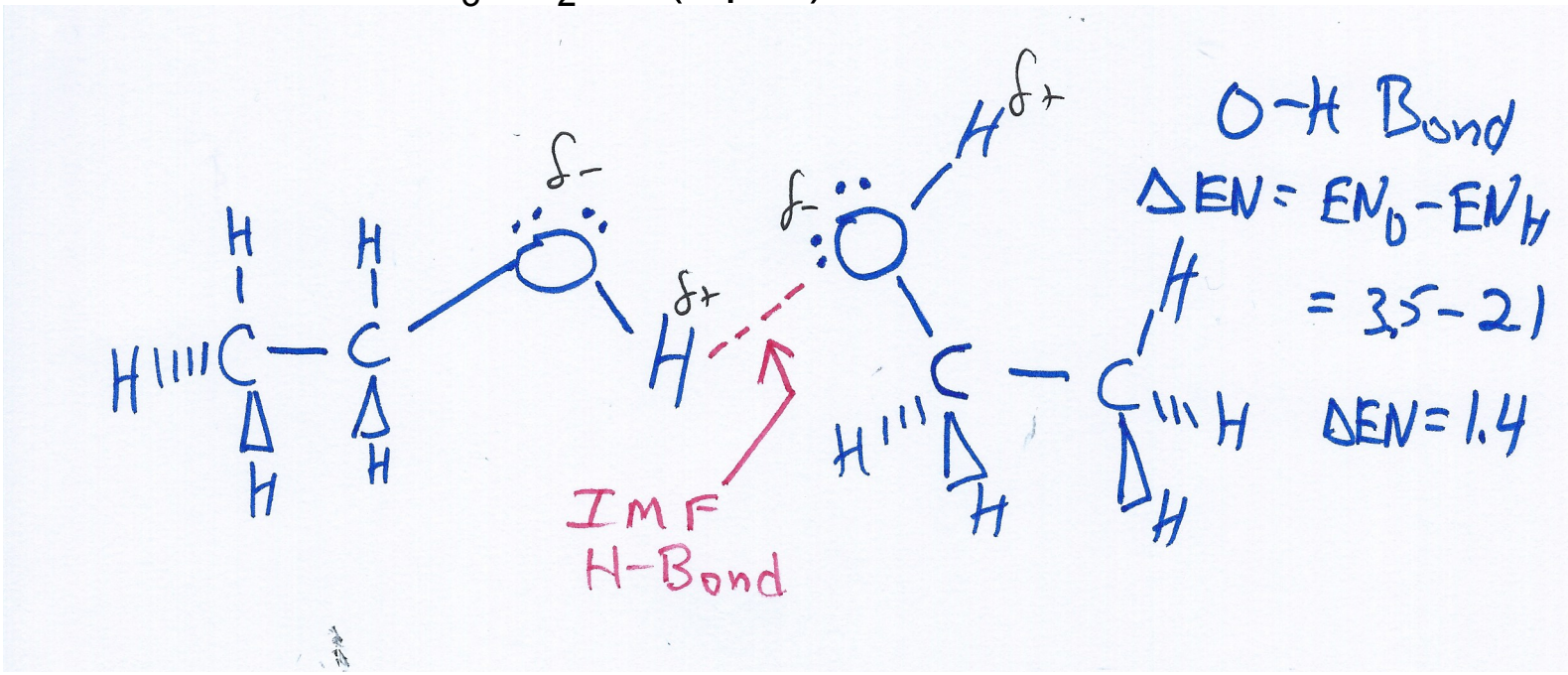
Compare the IMF between these two models and the IMF between the two $CH_3CH_2NH_2$ models. Which is stronger? Explain.

Sketch two 3D Lewis structures representing the two models and use a dashed line to show the correct location of the IMF.

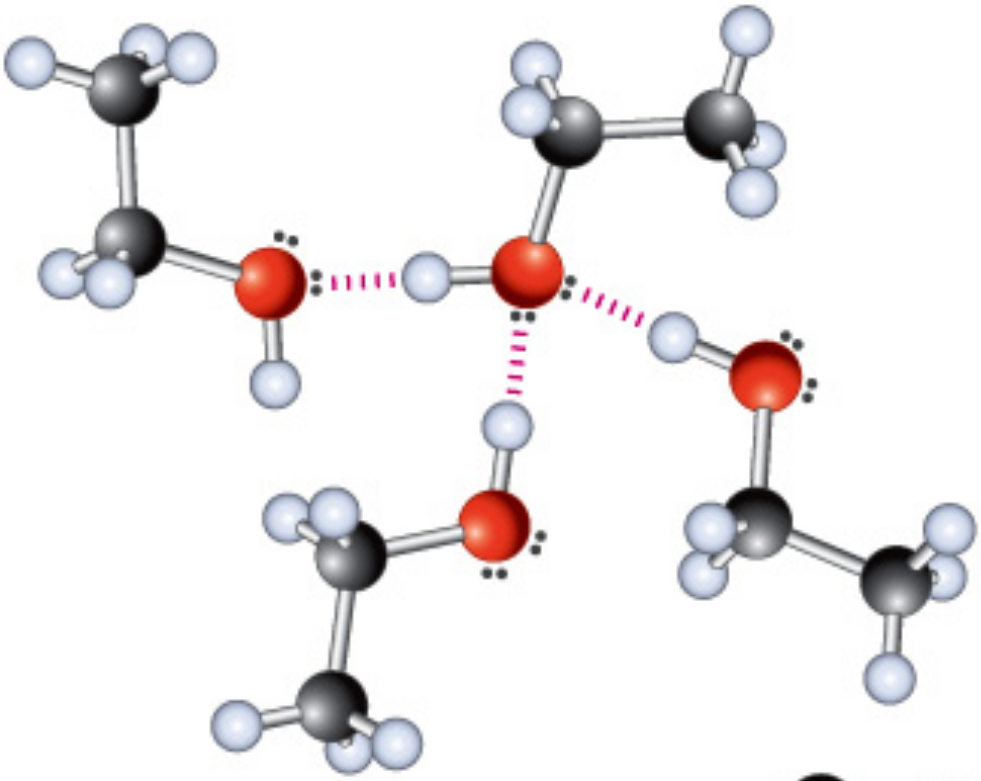
Hydrogen bond IMF



CH_3CH_2OH (liquid)



CH_3CH_2OH (liquid)



Ethanol

= carbon

= oxygen

= hydrogen

Which of the following does not form hydrogen bonds with other molecules?

A. CH_3-CH_2-NH_2
B. CH_3-CH_2-OH
C. CH_3-CH_2F

Which of the following liquids will have the higher boiling point? Explain.

A. CH_3-CH_2-NH_2

B. CH_3-CH_2-OH 

C. CH_3-CH_2F

Effect of Structure on Boiling Point

	CH_3CH_2F	$CH_3CH_2NH_2$ (liquid)
Molecular weight	48	45 g/mol
Boiling point, °C	-32	+17°C
Dipole moment, D	1.9	1.5

The electronegativity of N (3.0) is less than that of F (4.0), so N-H bonds (ΔEN = 0.9) are less polar than O-F bonds (ΔEN = 1.5). However, the total number of hydrogen bonds among $CH_3CH_2NH_2$ molecules results in a stronger overall attraction than the C - - - F dipole-dipole IMFs between CH_3CH_2F molecules.

This medium N- - - H hydrogen bonding IMF and the number of H Bonds leads to boiling points for 1° and 2° amines that are higher than those of halogen alkanes of comparable molecular mass.

$CH_3CH_2NH_2$ (liquid) b.p. = +17°C

CH_3CH_2F (liquid) b.p. = -32°C

Effect of Structure on Boiling Point

	CH_3CH_2OH(liquid)	$CH_3CH_2NH_2$ (liquid)
Molecular weight	46 g/mol	45 g/mol
Boiling point, °C	+78°C	+17°C
Dipole moment, D	1.69	1.5

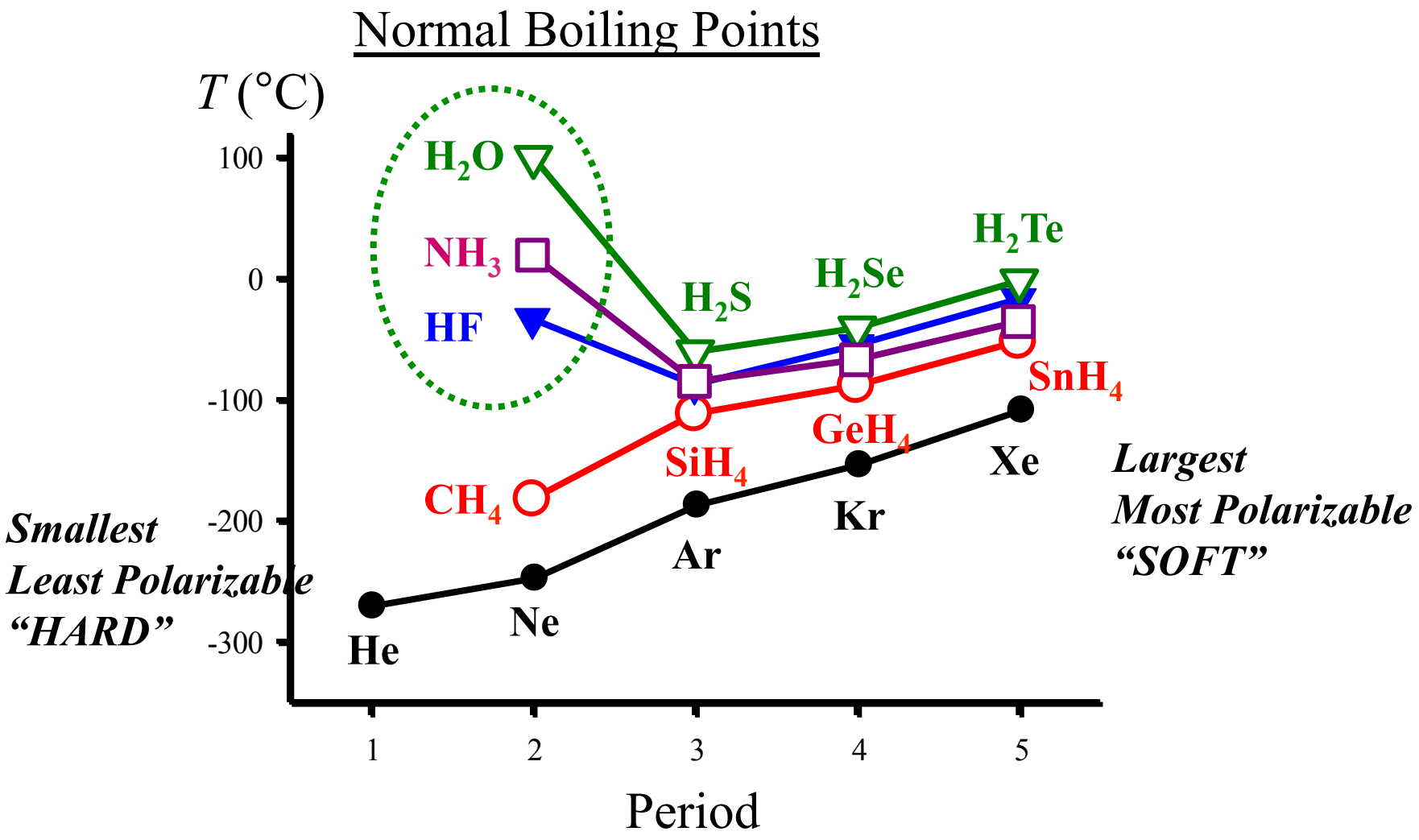
The electronegativity of N (3.0) is less than that of O (3.5), so N-H bonds (ΔEN = 0.9) are less polar than O-H bonds (ΔEN = 1.4), and their hydrogen bonds are correspondingly weaker than O-H hydrogen bonds.

This medium N - - - H hydrogen bonding IMF leads to boiling points for 1° and 2° amines that are significantly higher than those of halogen alkanes of comparable molecular mass, but significantly lower than those of comparable alcohols.

CH_3CH_2OH (liquid) b.p. = +78°C

$CH_3CH_2NH_2$ (liquid) b.p. = +17°C

Intermolecular Forces:



Hydrogen bond IMF between NH_3 molecules