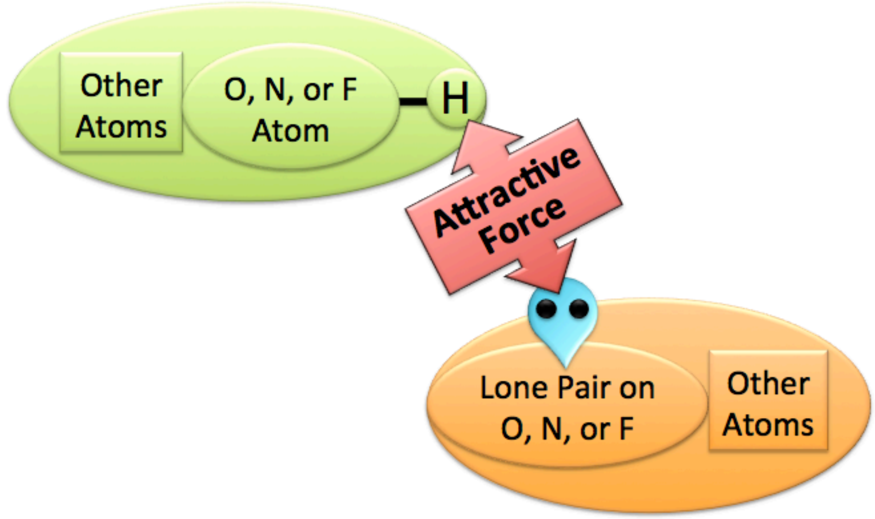
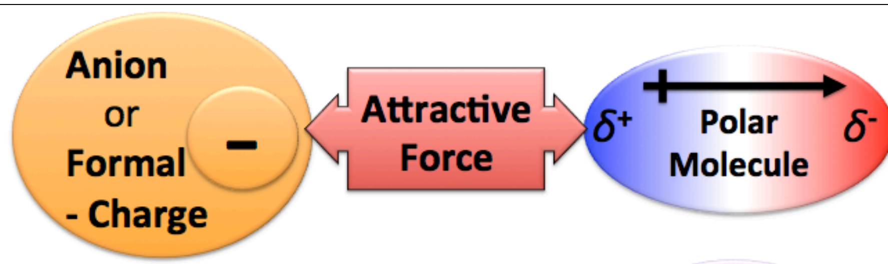
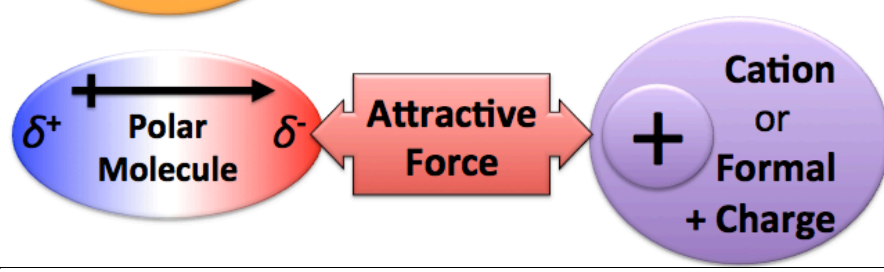
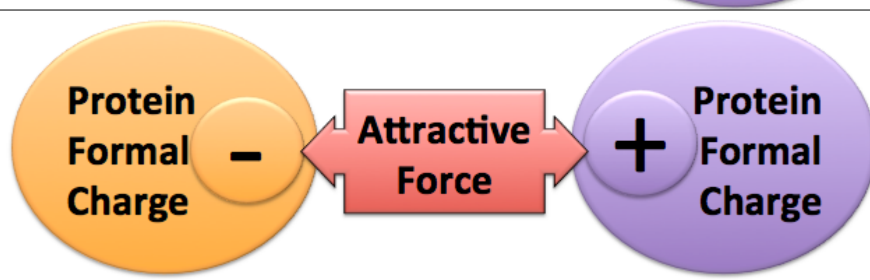
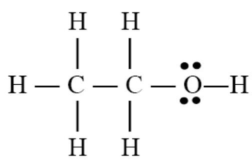
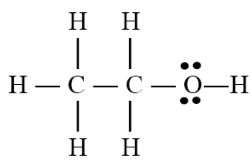
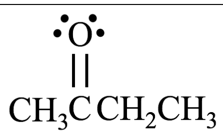
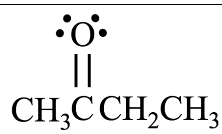
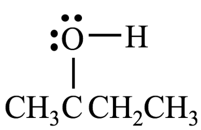
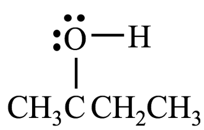
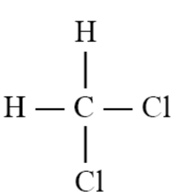
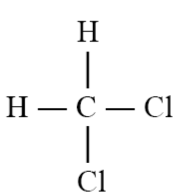
Noncovalent Interactions Worksheet and Key

Summary of Noncovalent Interactions:

Noncovalent Interaction	Interaction Between:
Hydrogen Bonding Electrostatic attractive force between the partially positive charged hydrogen end of an O-H, N-H, or F-H bond and the negative charge of a lone pair on an O, F, or N.	
Dipole-Dipole Electrostatic attractive force between *two* ***polar*** *molecules.*	
London Dispersion Forces Electrostatic attractive force between ***any*** *two molecules.*	
Ion-Dipole Electrostatic attractive force between a *dipole* and *an ion or formal charge.* The partially positive charge of a dipole is attracted to a negatively charged ion *or* a negative formal charge. The partially negative charge of a dipole is attracted to a positively charged ion *or* positive formal charge.	 
Salt Bridge Electrostatic attractive force between a negative formal charge and a positive formal charge in protein.	

Problems (see the key on the last two pages to check your work)

1) List **all** of the *noncovalent interactions* that can occur between the given pairs of molecules.

Molecules	**Noncovalent Interaction(s)** *Which noncovalent interactions occur between these pairs of molecules?*
Methane (CH_4) and Methane (CH_4)	
 and 	
H_2O and H_2O	
NH_3 and NH_3	
 and 	
 and 	
HCl and HCl	
CO_2 and CO_2	
CCl_4 and CCl_4	
 and 	

2) If the given pairs of substances in the table below were mixed together, list ***all of the noncovalent interactions*** that could occur.

Choices:

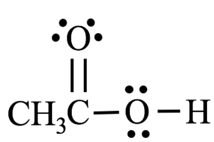
(A) Hydrogen bonding

(B) Dipole-dipole forces

(C) London dispersion forces

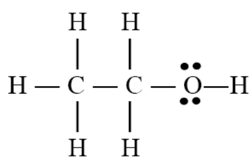
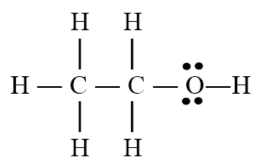
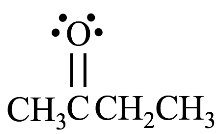
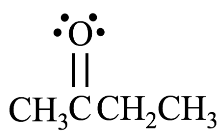
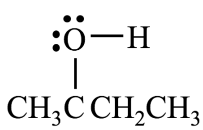
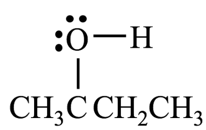
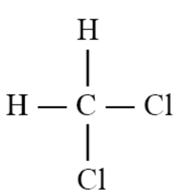
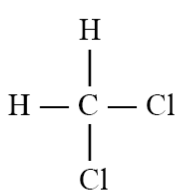
(D) Ion-dipole forces

(E) Salt bridges

Compound Pairs	**List of Noncovalent Interactions**
NH_3 and H_2O	
Mg^{2+} and H_2O	
Cl_2 and H_2	
Acetic acid and H_2O  Acetic Acid	
SO_2 and H_2O	
SO_2 and H_2S	
ethane (CH_3CH_3) and methane (CH_4)	

Key

1) List **all** of the *noncovalent interactions* that can occur between the given pairs of molecules.

Molecules	Noncovalent Interaction(s)
Methane (CH_4) and Methane (CH_4)	London dispersions forces
 and 	hydrogen bonding, dipole-dipole forces, London dispersions forces
H_2O and H_2O	hydrogen bonding, dipole-dipole forces, London dispersions forces
NH_3 and NH_3	hydrogen bonding, dipole-dipole force, London dispersions forces
 and 	dipole-dipole forces, London dispersions forces
 and 	hydrogen bonding, dipole-dipole forces, London dispersions forces
HCl and HCl	dipole-dipole forces, London dispersions forces
CO_2 and CO_2	London dispersions forces
CCl_4 and CCl_4	London dispersions forces
 and 	dipole-dipole forces, London dispersions forces

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Choices:

(A) Hydrogen bonding

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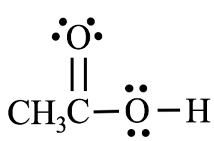
(C) London dispersion forces

(D) Ion-dipole forces

(E) Salt bridges

Compound Pairs	List of Noncovalent Interactions
NH_3 and H_2O	A, B, C
Mg^{2+} and H_2O	D (We will limit London dispersion forces to molecules and polyatomic ions; they are too small to be significant in monatomic **ions** in most applications)
Cl_2 and H_2	C
Acetic acid and H_2O  Acetic Acid	A,B,C
SO_2 and H_2O	A,B,C,D (There is a formal charge of (1-) on an oxygen in SO_2; consider the line bond structure and you will see an oxygen that has *just one single bond*.)
SO_2 and H_2S	B,C,D
ethane (CH_3CH_3) and methane (CH_4)	C