Problem Set 1 #1,3,4,6,7,9-12,14-16 KEY

1	
The following equations describe water boiling vs. water decomposing: $H_2O\ (l) \Rightarrow H_2O\ (g)$ $2H_2O\ (l) \Rightarrow 2H_2\ (g) + O_2\ (g)$ a)What types of bonds must be broken in each case? b)Given that water boils at 100°C but decomposes at 3000°C, what does thi say about the relative strength of the bonds involved in each case? Explain.	a) liquid => gas = imfs compound ⇒ elements = covalent bonds b)Since decomposition requires a much higher temperature, it implies that covalent bonds are much stronger than intermolecular forces.
3	
4. Is it possible for the dispersion forces in a particular substance to be stronger than the hydrogen bonding forces in another substance? Explain your answer.	Yes. When molecules become very large, they have more electrons and a greater surface area, making them more polarizable so that even though individual instances of dispersion may be weak, many such instances add up to an overall strong imf.
4	
35. Identify the most important types of interparticle forces present in the solids of each of the following substances. **a.** Ar **e.** CH_4 **b.** HCl **f.** CO **c.** HF **g.** $NaNO_3$ **d.** $CaCl_2$	a)dispersion b)dispersion, dipole-dipole c)dispersion, dipole-dipole, hydrogen bonding d)ionic bonds e)dispersion f)dispersion, dipole-dipole g)ionic bonds, covalent bonds (within the polyatomic ions)
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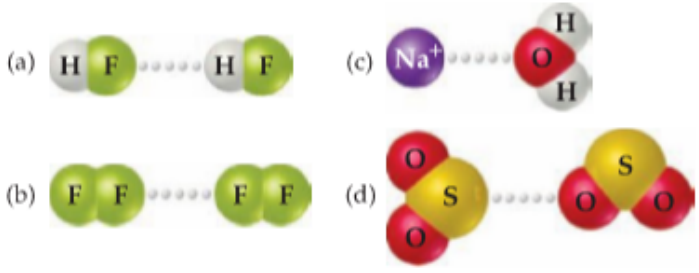
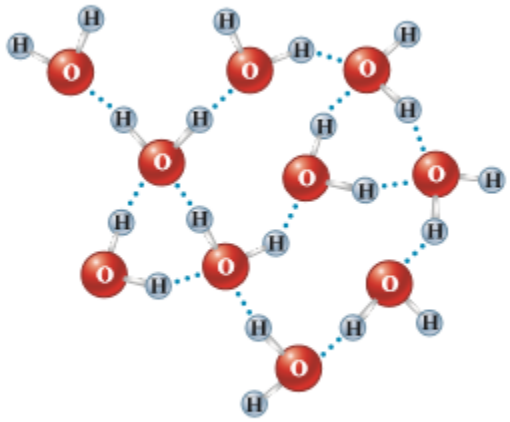
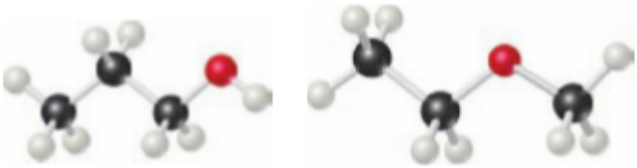
11.2 (a) What kind of intermolecular attractive force is shown in each of the following cases? **(b)** Predict which two interactions are stronger than the other two. [Section 11.2] 	a)hydrogen bonding b)dispersion c)ion-dipole d)dipole-dipole

7	
13. In the diagram below, which lines represent the hydrogen bonding?  **a.** the dotted lines between the hydrogen atoms of one water molecule and the oxygen atoms of a different water molecule **b.** the solid lines between a hydrogen atom and oxygen atom in the same water molecule **c.** Both the solid lines and dotted lines represent hydrogen bonding. **d.** There are no hydrogen bonds represented in the diagram.	Choice a!
9	
11.17 **(a)** What is meant by the term *polarizability*? **(b)** Which of the following atoms would you expect to be most polarizable: N, P, As, Sb? Explain. **(c)** Put the following molecules in order of increasing polarizability: $GeCl_4$, CH_4, $SiCl_4$, SiH_4, and $GeBr_4$. **(d)** Predict the order of boiling points of the substances in part (c).	a)The ability to shift electron density producing temporary dipoles in an atom or molecule. b)Sb - largest atoms with most electrons c)$CH_4 < SiH_4 < SiCl_4 < GeCl_4 < GeBr_4$
10	
11.18 True or false: **(a)** The more polarizable the molecules, the stronger the dispersion forces between them. **(b)** The boiling points of the noble gases decrease as you go down the column in the periodic table. **(c)** In general, the smaller the molecule, the stronger the dispersion forces. **(d)** All other factors being the same, dispersion forces between molecules increase with the number of electrons in the molecules.	a)true b)false c)false d)true
11	
37. Predict which substance in each of the following pairs would have the greater intermolecular forces. **a.** CO_2 or OCS **b.** SeO_2 or SO_2 **c.** $CH_3CH_2CH_2NH_2$ or $H_2NCH_2CH_2NH_2$ **d.** CH_3CH_3 or H_2CO **e.** CH_3OH or H_2CO	a)OCS - similar dispersion, but this one also has dip-dip b)SeO_2 - both are polar, but SeO_2 has greater dispersion c)$H_2NCH_2CH_2NH_2$ - 2 H-bond sites vs. 1 d)H_2CO - similar dispersion, but this one also has dip-dip

	e)CH_3OH - h-bonding
12 **11.23** **(a)** What atoms must a molecule contain to participate in hydrogen bonding with other molecules of the same kind? **(b)** Which of the following molecules can form hydrogen bonds with other molecules of the same kind: CH_3F, CH_3NH_2, CH_3OH, CH_3Br?	a)an O-H, N-H, or F-H bond and a lone pair b)CH_3NH_2, CH_3OH
14 **39.** Rationalize the difference in boiling points for each of the following pairs of substances: **a.** *n*-pentane $CH_3CH_2CH_2CH_2CH_3$ 36.2°C neopentane  9.5°C **b.** HF 20°C HCl −85°C **c.** HCl −85°C LiCl 1360°C **d.** *n*-pentane $CH_3CH_2CH_2CH_2CH_3$ 36.2°C *n*-hexane $CH_3CH_2CH_2CH_2CH_2CH_3$ 69°C	a)Pentane has the higher BP since it has a greater surface area for dispersion forces to occur b)HF has hydrogen bonding c)LiCl is held by ionic bonds, which are much stronger than imfs d)hexane is larger, with more electrons, is more polarizable, and so has greater dispersion force
15 **11.21** Butane and 2-methylpropane, whose space-filling models are shown, are both nonpolar and have the same molecular formula, yet butane has the higher boiling point (−0.5 °C compared to −11.7 °C). Explain.  (a) Butane (b) 2-Methylpropane	Butane has the higher BP since it has a greater surface area for dispersion forces to occur
16 **11.5** The following molecules have the same molecular formula (C_3H_8O), yet they have different normal boiling points, as shown. Rationalize the difference in boiling points.  (a) Propanol 97.2 °C (b) Ethyl methyl ether 10.8 °C	Both molecules have similar dispersion and dipole-dipole attractions, but propanol is able to hydrogen bond to other molecules due to the O-H group making the overall imf stronger.