Chemistry 222 Oregon State University
Worksheet 4 Notes

1. Place the following compounds in order of **<u>decreasing</u>** strength of intermolecular forces.

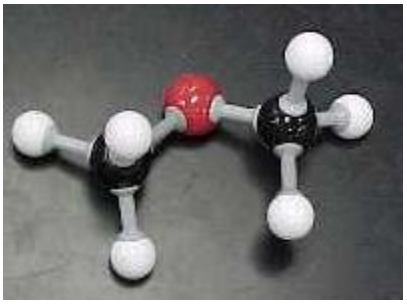
HF O_2 CO_2

HF > CO_2 > O_2

2. In liquid propanol, $CH_3CH_2CH_2OH$, which intermolecular forces are present?

Dispersion, hydrogen bonding and dipole-dipole forces are present.

3. Consider dimethyl ether, CH_3OCH_3. The intermolecular forces present in CH_3OCH_3 are:

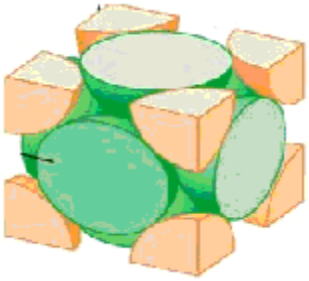


Dispersion forces and dipole-dipole forces.

4. The equivalent number of atoms in the FCC unit cell is_____.

4

5. The structure below represents:



An SC unit cell, a BCC unit cell, **an FCC unit cell, a** cell phone, or a prokaryotic cell.

6. Which of the following sets of compounds are expected to be soluble in water?

(A) CH_4, CO_2, CF_4

(B) NaCl, CH_4, CH_3OCH_3

(C) NaCl, CH_3CH_2OH, NH_3

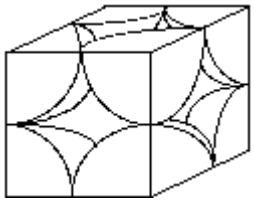
(D) NaCl, CCl_4, C_4H_{10}

7. 1. List the following from lowest to highest melting point: calcium chloride, Ne, diamond, water, CH_3OCH_3, CH_3CH_2OH, O_2, sodium chloride, lithium chloride.

Ne < O_2 < CH_3OCH_3, CH_3CH_2OH < water < NaCl < LiCl < $CaCl_2$ < diamond

8. Sketch the SC unit cell. The equivalent number of atoms in the SC unit cell is _____.

8 x 1/8 = 1



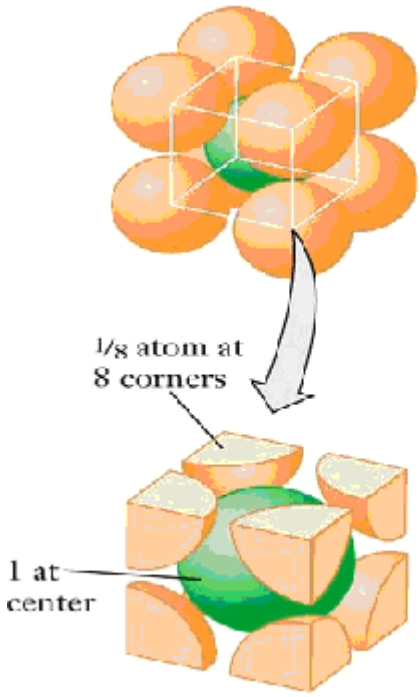
Sketch the BCC unit cell. The equivalent number of atoms in the BCC unit cell is _____.

8 x 1/8

+ 1 x 1

———

2



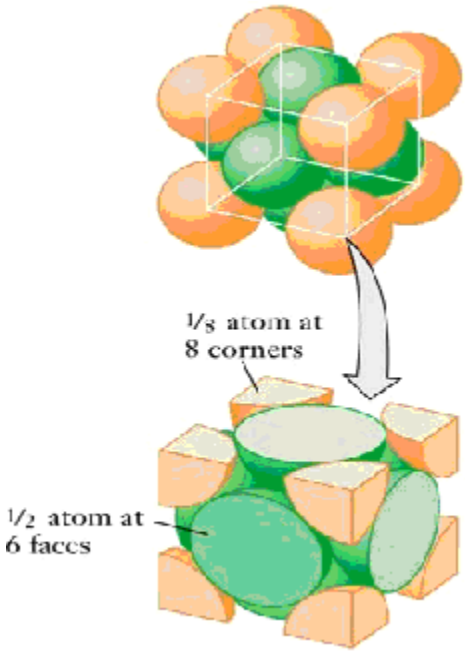
Sketch the FCC unit cell. The equivalent number of atoms in the FCC unit cell is _____. Which unit cell offers the best packing (least amount of void)?

8 x 1/8

\+ 6 x 1/2

_____

4



9. Discuss why water has a higher boiling point than ethanol, than methanol, than carbon disulfide.

Outstanding hydrogen bonding.

10. List six molecules which exhibit dispersion forces and no other intermolecular forces. Explain.

(Non-polar, no hydrogen bonding)

CO_2, He (not really a molecule, but..), O_2, N2, CH_4, CF_4

plus many others

11. List six molecules which exhibit dipole-dipole intermolecular forces and not hydrogen bonding. Explain.

(Polar, no hydrogen bonding)

NO, CH_3F, CH_3OCH_3...

12. List six molecules which exhibit H-bonding. Explain.

H_2O, CH_3OH and CH_3CH_2OH (alcohols), NH_3, HF...

13. Why does water boil at 100 °C (oh that's high!)? Outstanding hydrogen bonding.

14. List and draw six molecules that you expect to be soluble in water. Are these polar or non-polar?

Polar! Alcohols, ethers, CH_3F...

15. List and draw six molecules that you expect to be soluble in a non-polar solvent such as CCl_4. Are these polar or non-polar?

Non-polar!

16. How does soap work? Long chains with a hydrophobic end and a hydrophilic end.

17. Consider CH_3CH_2OH. The intermolecular forces present in CH_3CH_2OH are:

(a) dispersion forces only, (b) dipole-dipole forces only, (c) dispersion forces and dipole-dipole forces only, (d) dispersion forces, dipole-dipole forces, and hydrogen bonding, (e) hydrogen bonding only. (Choose one).

18. List the following from lowest to highest boiling point: water, methane, trifluoromethane, ethanol, lithium chloride.

methane < trifluoromethane < ethanol < water < lithiu chloride

molecules (with weakest IMF on left) < ionic compounds

19. List the following from lowest to highest melting point: aluminum oxide, lithium chloride, calcium chloride.

$LiCl < CaCl_2 < Al_2O_3$

+1/-1 +2/-1 +3/-2

20. Which has a higher boiling point, He or Kr? Why?

Kr, it has better dispersion forces (more electrons, heavier).

21. Which of the following is **false**?

(A) Quartz, graphite, and diamond are network covalent compounds

(B) Sodium oxide is an ionic compound

(C) Methanol (CH_3OH) is a polar molecule which exhibits hydrogen bonding

(D) Sodium oxide melts at a higher temperature than methanol

(E) Argon melts at a higher temperature than methanol

22. The cubic form for the fictitious element Oregonium is FCC. The atomic radius is 132.0 pm and the density is 34.2 g/cm^3. Determine the molar mass of Oregonium.

1 m = 1 x 10^{12} pm
1 m = 100 cm
For Simple Cubic: $l = 2r$
For BCC: $l = 4r/\sqrt{3}$
For FCC: $l = 4r/\sqrt{2}$

267.4 g/mol