**Ch 12 Liquids, Solids, and IMFs Name:**

*12.1 Water, No Gravity* Read this section.

*12.2 Solids, Liquids, and Gases: A Molecular Comparison*

In terms of IMFs what is the difference between the 3 states of matter? *Table 12.2*

What is the difference between crystalline and amorphous solids?

In what 2 ways can we transform substances from on state to another?

*11.3 IMFs: The Forces That Hold Condensed States Together*

What determines if a substance is S, L, or G?

Why are IMFs weaker than bonding forces?

Dispersion (or \_\_\_\_\_\_\_\_\_\_\_ force) are the result of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s in the electron \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

within molecules or atoms. *Since all atoms and molecules have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s they all exhibit LDFs (London*

*dispersion forces).* The diagrams (middle pg500) show how the 2 electrons in He can end up on the same side

which cause the formation of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ary dipole. The next diagram shows how

the instantaneous dipole can in\_\_\_\_\_ dipoles on neighboring atoms which then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ each other.

What does the magnitude of the LDF depend on? (EXAMPLE: *Table 12.3*)

Why does n-pentane have higher LDFs than neopentane even though they have the same \_\_\_\_\_\_\_\_\_\_ mass?

*Figure 12.5*

*Figure 12.6* shows that as the length and mass of *straight* chained hydrocarbons increase the electron cloud of the molecule increases and becomes more POLARIZABLE. What affect does this have on boiling point?

*CC 12.3 \_\_\_\_ Explain why.*

*­*The \_\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_ force exists BETWEEN all molecules that are \_\_\_\_\_\_\_\_\_\_\_ such as \_\_\_\_\_\_\_\_\_\_\_\_\_.

Think back to the bonding unit. Why is acetone polar? *(2 requirements?) Figure 12.2*

Why does acetone also exhibit LDFs?

Why does formaldehyde have a higher bp and mp than ethane even though they have ***similar*** molar masses?

*Figure 12.8* shows data to reinforce this idea. (dipole moment is a measure of the polarity of a molecule)

As dipole moment \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s \_\_\_\_\_\_\_\_\_\_\_\_\_ points increase (due to increased attractions).

The detailed reasons why water and pentane are not miscible*(Figure 12.9)* will be discussed in the next chapter.

What forces *should* cause these substances to be *attracted* to one another?

*Practice 12.1 \_\_\_\_\_\_\_\_\_ Which ones “have”(exhibit) LDFs? \_\_\_\_\_\_\_\_\_\_*

Polar molecules containing \_\_\_ atoms bonded directly to small \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atoms most importantly-

\_\_\_, \_\_\_, or \_\_\_ - exhibit an IMF called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonding. The H-bond is sort of a \_\_\_\_\_\_\_ dip-dip force.

See *Figure 12.10 with HF as an example.* H-bonds should NOT be confused with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds.

Chemical bonds occur \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ individual \_\_\_\_\_\_\_ in a molecule where as IMFs (like H-bonds) are

attractive forces that occur \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules. *(intra vs inter)*  A typical H-bond is only \_\_-\_\_% as

strong as a typical \_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond (even though H-bonds are the strongest IMFs).

Ethanol and dimethyl ether have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (so they are \_\_\_\_mers). Why do their bp’s and mp’s differ so much? *(this is a classic example!)*

*Note how H-bonds are represented by •••• lines betw the H on one molecule and the N, O, or F on the other molecule.*

What is shown in general by the graphs in *Figure 12.13*? Why does water break the trend?

*Review Example 11.2 and complete Practice 11.2*

What do the Ion-Dipole forces shown in *Figure 12.14* show about why NaCl dissolves in water?

*Table 12.4* shows examples and relative strengths of the 3 IMFs and ion-dipole forces (not technically an IMF).

*CC 12.5 ­­­\_\_\_\_\_\_* Explain your choice.

Read *Chemistry and Medicine: Hydrogen Bonding in DNA* The diagrams in this article are often used in AP tests as examples of H-bonding. Answer the question.

*12.4 IMFs in Action: Surface Tension, Viscosity, and Capillary Action*

How does surface tension form? Why is water the perfect substance to form surface tension?

What is viscosity?

What 3 things does viscosity of a substance depend on? *(Note how Table 12.5 and 12.6 show 2 of these.)*

Read *Chemistry in Your Day: Viscosity and Motor Oil* How can oils have SAE multigrade ratings like 10W-40?

What *REALLY* causes the blood to be “drawn” into the capillary tube at the top of pg 512?

*(What really causes the 2 forces?)*

Why does mercury form a convex meniscus while water forms a concave meniscus?

*12.5 Vaporization and Vapor Pressure*

What is vaporization?

What does Figure 12.24 show about vaporization?

Why does water in a beaker evaporate slower than water spilled on the floor?

Why does acetone (main component of \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ remover) evaporate more easily than water?

*CC12.6 \_\_\_\_*

Acetone is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ liquid. Motor oil is more \_\_\_\_\_\_\_\_\_\_\_\_\_. (see article about oil [here](http://oil-synthetic.com/2014/05/05/low-volatility-motor-oil-helps-unlock-vehicle-performance/))

Why is vaporization (evaporation) endothermic while condensation is exothermic?

*Table 12.7* show the Δ*Hvap* for a few substances. *Note how the value changes sign for the evaporation vs condensation of water in the paragraph above.*

*Practice 12.3 More Practice 12.3*

What does flask “c” in *Figure 12.25* and *Figure 12.26* show?

Weak IMFs result in \_\_\_\_\_\_\_\_\_\_\_\_\_ substances with \_\_\_\_\_\_\_ vapor pressures because IMFs are easily

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by \_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Strong IMFs result in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ substances with

\_\_\_\_\_\_\_\_\_\_\_\_ vapor pressures. *CC 12.7 \_\_\_\_*

What happens when a system in dynamic equilibrium is disturbed? *(Figure 12.27)*

*Figure 12.28* Shows 2 things: as temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_s the vapor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a substance

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s and when the vapor pressure of a substance reaches \_\_\_\_\_torr the \_\_\_\_\_\_\_\_\_\_\_ boiling

point of the substance can be determined. What happens if more heat is added to a liquid at its bp?

What doesn’t happen?

What is shown by *Table 12.8*?

The Clausius-Clapeyron equation shows the relationship between the \_\_\_\_\_\_\_\_\_\_\_\_ log of v.p. and the

\_\_\_\_\_\_\_\_\_\_\_\_\_ of temperature. (It is a convenient way to determine the v.p. of a liquid. Not required by AP.

The 2 point form of the equation can be used to predict the v.p. of a liquid at any temperature.

How does a supercritical fluid form?

Why is supercritical CO2 used to decaffeinate coffee?

*12.6 Sublimation and Fusion*

How are water molecules at the surface of a block of ice able to undergo sublimation?

How can sublimation/deposition be a problem in a freezer?

Dry ice sublimes at \_\_\_\_\_\_. How would it be possible to make dry ice melt?

Examine *Figure 12.34* – As ice at -10oC is heated to 0oC, what is happening to the water molecules in the solid?

What happens to the water molecules along the flat line where heat is added but the temperature does not change? Where does the energy go?

Melting is also called \_\_\_\_\_\_\_\_\_\_\_\_ *(as 2 solids melt they “fuse” together)*. The heat of fusion Δ*Hfus* can be used to refer to the energy change of melting or freezing. Why is freezing an exothermic process?

Why are the heats of fusion so much lower than heats of vaporization for the substances shown in *Figure 12.35*?

*12.7 Heating Curve for Water*

How does the heating curve for water *(Figure 12.36)* show that the heat of fusion is much less than the heat of vaporization?

Notice the slopes of the lines at 1, 3, and 5. What do the slopes indicate about the energy needed to change the temperature of liquid water vs ice or steam?

*Review the calculations on pgs 525-6. AP assumes this is “previous knowledge”.*

*CC 12.9 Do the calculations for a 10 g ice cube. Remember water is 18g/mol and 1kJ =1000J*

qice warms = 10.g x 2.09J/g∙oC x 10oC x 1kJ/1000J = qice melts = 10.g x 1mol/18g x 6.02kJ/mol =

*12.8 Phase Diagrams Again AP assumes this section is “previous knowledge”.*

Examine the phase diagram for water *Figure 12.37* and be able to “navigate” the diagram.

Look at the navigation line at 1atm in *Figure 12.38* – As you move across the line you are basically following the same path as the heating curve for water shown in *Figure 12.36.* Imagine a vertical line drawn at -10oC.

Use this path to explain what happens under the blade of an ice skate as you glide across the ice.

When will CO2 melt?

Iodine crystals will *slowly* sublime at room temperature and 1atm. Why is this possible even though the curve does not show it?

*12.9 Water: An Extraordinary Substance* Read this section. NOTE: *Figure 12.40*

*Exercises* (pgs 536-542) #49, 51, 53, 54&120, 55, 59, 62, 63, 67, 79, 81, 93, 117, 143, 121 Extra 119

**Ch 13 Solids and Modern Materials**

*13.2 X-ray Crystallography*

*13.3 Crystalline Solids: Unit Cells and Basic Structures*

Both of these sections are not required by AP. They may be part of a college level intro class. It is interesting to see how x-rays were used to determine the structure of substances.

*13.4 Crystalline Solids: Fundamental Types*

Molecular solids are held together by \_\_\_\_\_s. As a whole they tend to have \_\_\_\_\_mps.

H-bonding can \_\_\_\_\_\_\_\_\_\_\_mp of some.

Ionic solids are composed of \_\_\_\_ held together by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ attractions between \_\_\_ions and \_\_\_\_ions in

the lattice. These forces are much stronger than IMFs so ionic compounds tend to have \_\_\_\_\_\_\_\_\_mps than molecular solids.

Noble gases form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atomic solids. Iron and gold form \_\_\_\_\_\_\_\_\_\_\_\_\_\_ atomic solids held

together by \_\_\_\_\_\_\_\_\_\_\_\_\_ bonds (\_\_\_\_ of electrons). Diamond, graphite, and silicon dioxide are \_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atomic solids. How is diamond different than graphite even though they are both carbon?

*13.6 Network Covalent Atomic Solids*

Notice in the structures of quartz and glass *(Figure 13.18)* the silicon and oxygen atoms for network bonds in repeating tetrahedral, there are NOT independent SiO2 molecules. This makes the mp for quartz much higher than molecular solids.

*13.8 Crystalline Solids: Band Theory* This is an interesting section about how MOT can explain why metals conduct and how semiconductors work. AP no longer requires this knowledge.

*13.9 Polymers and Plastics* (AFTER AP Exam)