AP Chemistry Problem Set Chapter 10 **Name___________________**

Due: Monday, January 8th, 2007

30 points – 5 points for completion, 3 random essay problems will be graded, each worth 5 points. Each multiple choice must be answered (1 point each). Staple this sheet to the front of your essay responses.

Multiple Choice. Please indicate your multiple choice answers below.

1. **C – 66%** 2. **A – 56%** 3. **E – 57%** 4. **A – 72%** 5. **B – 44%**

6. **D – 55%** 7. **C – 50%** 8. **D – 65%** 9. **A – 73%** 10. **B – 66%**

Use the following answers for questions 1 - 2. **(1984 - #8 & 9)**

(A) A network solid with covalent bonding
(B) A molecular solid with zero dipole moment
(C) A molecular solid with hydrogen bonding
(D) An ionic solid
(E) A metallic solid

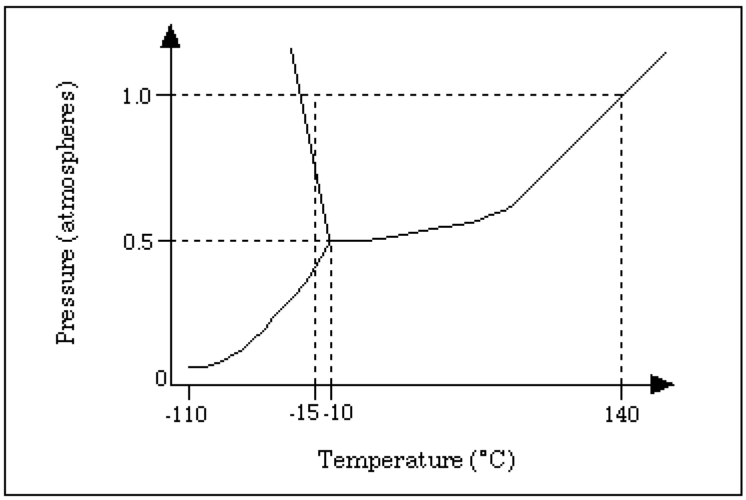
1. Solid ethyl alcohol, C_2H_5OH **(C)**
2. Silicon dioxide, SiO_2 **(A)**

Use these answers for questions 3-6 **(1989 #11 – 14)**

(A) hydrogen bonding (B) hybridization (C) ionic bonding
(D) resonance (E) van der Waals forces (London dispersion forces)

3. Is used to explain why iodine molecules are held together in the solid state **(E)**
4. Is used to explain why the boiling point of HF is greater than the boiling point of HBr **(A)**
5. Is used to explain the fact that the four bonds in methane are equivalent **(B)**
6. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C_6H_6, are identical **(D)**

Use the following diagram for questions 7-8
(1989 - #49&51)

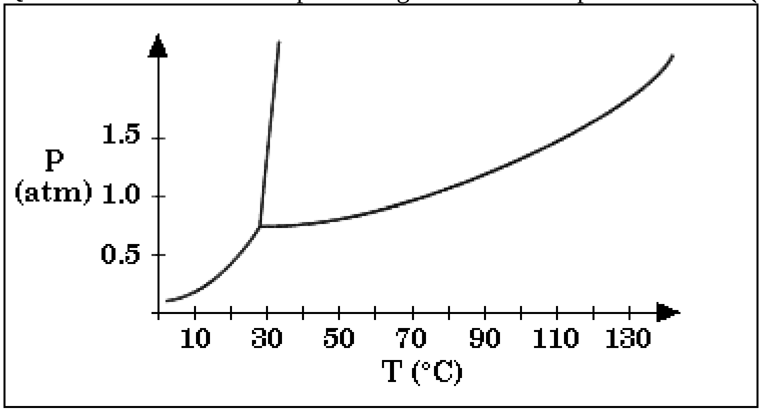


7. The normal boiling point of the substance represented by the phase diagram above is
(A) -15 °C (B) -10 °C
(C) 140 °C (D) greater than 140 °C
(E) not determinable from the diagram

8. For the substance represented in the diagram, which of the phases is most dense and which is least dense at - 15 °C.

	Most Dense	Least Dense
(A)	Solid	Gas
(B)	Solid	Liquid
(C)	Liquid	Solid
(D)	**Liquid**	**Gas**
(E)	The diagram gives no information about densities.	

Questions 9-10 refer to the phase diagram below of a pure substance. **(1994 – #5 & 7)**



(A) Sublimation (B) Condensation (C) Solvation
(D) Fusion (E) Freezing

9. If the temperature increases from 10° C to 60° C at a constant pressure of 0.4 atmospheres, which of the processes occurs? **(A)**

10. If the pressure increases from 0.5 to 1.5 atmospheres at a constant temperature of 50° C, which of the processes occurs? **(B)**

Essay

1985 - #9

Substance	Melting Point, °C
H_2	-129
C_3H_8	-190
HF	-92
CsI	621
LiF	870
SiC	>2,000

(a) Discuss how the trend in the melting points of the substances tabulated above can be explained in terms of the types of attractive forces and/or bonds in these substances.

H_2 and C_3H_8 have low melting points because the forces involved are the weak van der Waals (or London) forces.

HF has a higher melting point because intermolecular hydrogen bonding is important.

CsI and LiF have still higher melting points because ionic lattice forces must be overcome to break up the crystals and the ionic forces are stronger than van der Waals forces and hydrogen bonds.

SiC is an example of a macromolecular substance where each atom is held to its neighbors by a very strong covalent bond.

(b) For any pairs of substances that have the same kind(s) of attractive forces and/or bonds, discuss the factors that cause variation in the strengths of the forces and/or bonds.

C_3H_8 and H_2: There are more interactions per molecule in C_3H_8 than in H_2. Or C_3H_8 is weakly polar and H_2 is nonpolar.

LiF and CsI: The smaller ions in LiF result in a higher lattice energy than CsI has. Lattice energy U is proportional to $1 / (r^+ + r^-)$

1988 - #5 Average score: 2.99 out of 8

Using principles of chemical bonding and/or intermolecular forces, explain each of the following.

(a) Xenon has a higher boiling point than neon has.

Xe and Ne are monatomic elements held together by London dispersion (van der Waals) forces. The magnitude of such forces is determined by the number of electrons in the atom. A Xe atom has more electrons than a neon atom has. (Size of the atom was accepted but mass was not.)

(b) Solid copper is an excellent conductor of electricity, but solid copper chloride is not.

The electrical conductivity of copper metal is based on mobile valence electrons (partially filled bands). Copper chloride is a rigid ionic solid with the valence electrons of copper localized in individual copper (II) ions.

(c) SiO_2 melts at a very high temperature, while CO_2 is a gas at room temperature, event though Si and C are in the same chemical family.

SiO_2 is a covalent network solid. There are strong bonds many of which must be broken simultaneously to volatize SiO_2. CO_2 is composed of discrete, nonpolar CO_2 molecules so that the only forces holding the molecules together are the weak London dispersion (van der Waals) forces.

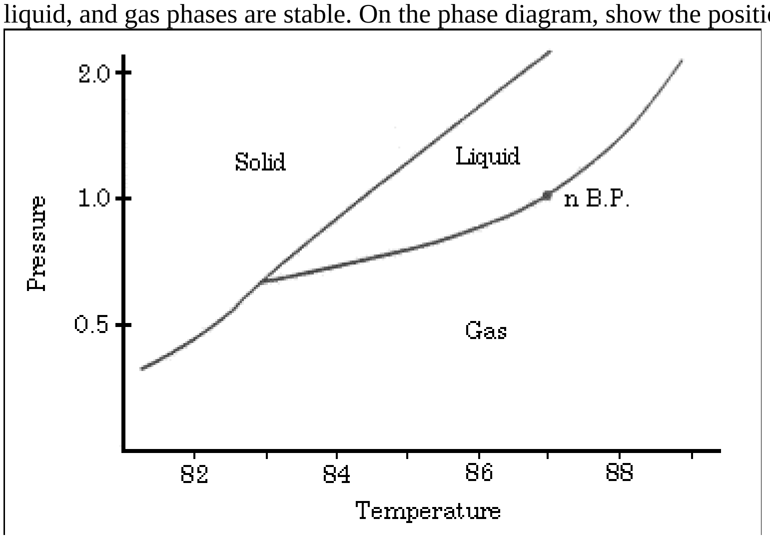
(d) Molecules of NF_3 are polar, but those of BF_3 are not.

A lone pair of electrons on the central atom results in a pyramidal shape. The dipoles don't cancel, thus the molecule is polar. There is no lone pair on the central atom so the molecule has a trigonal planar shape in which the dipoles cancel, thus the molecule is nonpolar.

1988 - #8 Average Score: 3.82 out of 8

The normal boiling and freezing points of argon are 87.3 K and 84.0 K, respectively. The triple point is at 82.7 K and 0.68 atmosphere.

(a) Use the data above to draw a phase diagram for argon. Label the axes and label the regions in which the solid, liquid, and gas phases are stable. On the phase diagram, show the position of the normal boiling point.



(b) Describe any changes that can be observed in a sample of solid argon when the temperature is increases from 40 K to 160 K at a constant pressure of 0.50 atmospheres.

The argon sublimes.

(c) Describe any changes that can be observed in a sample of liquid argon the pressure is reduced from 10 atmospheres to 1 atmosphere at a constant temperature of 100 K, which is well below the critical temperature.

The argon vaporizes.

(d) Does the liquid phase of argon have a density greater than, equal to, or less than the density of the solid phase? Explain your answer, using information given in the introduction to this question.

The liquid phase is less dense than the solid phase. Since the freezing point of argon is higher than the triple point temperature, the solid-liquid equilibrium line slopes to the right with increasing pressure. Thus, if a sample of liquid argon is compressed (pressure increased) at constant temperature, the liquid becomes a solid. Because increasing pressure favors the denser phase, solid argon must be the denser phase.

1989 - #6 Average Score: 1.6 out of 8
The melting points of the alkali metals decrease from Li to Cs. In contrast, the melting of the halogens increases from F_2 to I_2.
(a) Using bonding principles, account for the decrease in the melting point of the alkali metals.
Alkali metals have metallic bonds: cations in a sea of electrons. As cations increase in size (Li to Cs), charge density decreases and attractive forces (and melting points) decreases.
(b) Using bonding principles, account for the increase in the melting points of the halogens.
Halogen molecules are held in place by dispersion (van der Waals) forces: bonds due to temporary dipoles caused by polarization of electron clouds. As molecules increase in size (F_2 to I_2), the larger electrons clouds are more readily polarized, and the attractive forces (and melting points) increase.
(c) What is the expected trend in the melting points of the compounds LiF, NaCl, KBr, and CsI? Explain this trend using bonding principles.
Melting point order: LiF > NaCl > KBr > CsI
Compounds are ionic
Larger radii of ions as listed
Larger radii leads to smaller attraction and lower melting points.

1992 - #8 Average Score: 3.0 out of 8
Explain each of the following in terms of atomic and molecular structures and/or intermolecular forces.
(a) Solid K conducts an electric current, whereas solid KNO_3 does not.
K conducts because of its metallic bonding or "sea" of mobile e's (or "free" e's) KNO_3 does not conduct because it is ionically bonded and has immobile ions (or imm. e's)
(b) $SbCl_3$ has a measurable dipole moment, whereas $SbCl_5$ does not.
$SbCl_3$ has a measurable dipole moment because it has a lone pair of e's which causes a dipole or its dipoles do not cancel or it has a trigonal pyramidal structure or clear diagram illustrating any of the above $SbCl_5$ has no dipole moment because its dipoles cancel or it has a trigonal bipyramidal structure
(c) The normal boiling point of CCl_4 is 77 °C, whereas that of CBr_4 is 190 °C.
CBr_4 boils at a higher T than CCl_4 because it has stronger intermolecular forces (or van der Waals or London dispersion). These stronger forces occur because CBr_4 is larger and/or has more electrons than CCl_4.
(d) NaI(s) is very soluble in water whereas I_2(s) has a solubility of only 0.03 gram per 100 grams of water.
NaI has greater aqueous solubility than I_2 because NaI is ionic (or polar) whereas I_2 is nonpolar (or covalent). H_2O, being polar, interacts with the ions of NaI but not with I_2. (Like dissolves like accepted if polarity of H_2O clearly indicated.)