ADVANCED PLACEMENT CHEMISTRY
CHAPTER 10 PROBLEMS

1. a) Distinguish between intramolecular forces and intermolecular forces.
   b) Which of these changes, during a phase change?
   c) Name and describe 3 types of intermolecular forces.

2. Which of the following would you expect to show
   a) dispersion forces as the major attractive forces?
   b) dipole forces as the major attractive forces?
   Cl_2, $GeCl_2$, $CHCl_3$, CCl_4

3. Which of the following would show hydrogen bonding?
   CH_3F, NH_3, H_3COCH_3, $[H\text{-}F\text{-}H]^+$

4. Identify the most important types of interparticle forces present in the solids of each of the following substances.
   a) NH_4Cl
   b) $CF_3(CF_2CF_2)_nCF_3$ (teflon)
   c) $CH_3(CH_2CH_2)_nCH_3$ (polyethylene)
   d) $CHCl_3$
   e) NH_3
   f) NO
   g) BF_3

5. Consider the compounds Cl_2, HCl, F_2, NaF, and HF. Which compound has a boiling point closest to that of argon? Explain.

6. Consider the following compounds and their condensed structural formulas.

Ethanol	CH_3CH_2OH
Dimethyl ether	CH_3OCH_3
Propane	$CH_3CH_2CH_3$

   The boiling points of these compounds are (in no particular order) -42.1 ^oC, -23 ^oC, and 78.5 ^oC. Match the boiling points to the correct compounds.

7. Arrange the following in order of decreasing boiling point. Explain.
   I_2, F_2, Cl_2, Br_2

8. Arrange the inert gases in order of decreasing freezing points. Explain the trend.

9. Explain in terms of intermolecular forces why
   a) Br_2 is lower melting than NaBr
   b) C_2H_5OH is higher boiling than butane, C_4H_{10}
   c) Water is higher boiling than hydrogen telluride, H_2Te
   d) Acetic acid, H_3CCOOH, is lower boiling than benzoic acid, C_6H_5COOH?

10. Propane is a gas at room temperature, hexane is a liquid, and octadecane is a solid. Explain.

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11. Explain the differences in enthalpy changes for the following:

$H_2O\ (s) \rightarrow H_2O\ (l)$ $\quad \Delta H^o_{fus} = 6.02$ kJ/mol

$H_2O\ (l) \rightarrow H_2O\ (g)$ $\quad \Delta H^o_{vap} = 40.7$ kJ/mol

12. Explain the following trends
    a) Group 4A hydrides show an increase in boiling point in going down a group.
    b) Group 6A compounds containing hydrogen also show an increase in boiling point going down a group except for H_2O.
    c) How do groups 5A and 7A compounds containing hydrogen compare to the previous 2 groups and why?

13. What are the strongest attractive forces that must be overcome to
    a) melt ice
    b) boil carbon tetrachloride
    c) sublime bromine

14. For each of the following pairs, choose the member with the lower boiling point. Explain your reason in each case.
    a) AsH_3 or PH_3
    b) C_6H_6 or $C_{10}H_8$
    c) NH_3 or PH_3
    d) LiCl or C_3H_8

15. Decide which substance in each of the following pairs has the lower melting point. Explain how you made each choice.
    a) KCl or CaO
    b) CCl_4 or C_2Cl_6
    c) CH_3COOH or C_2H_5Cl
    d) Na or Cs
    e) MgO or BaO

16. The nonpolar hydrocarbon $C_{25}H_{52}$ is a solid at room temperature. Its boiling point is greater than 400 ^oC. Which has the stronger intermolecular forces, $C_{25}H_{52}$ or H_2O? Explain your answer**.**

17. Describe the following properties of water: surface tension, capillary action, cohesive forces, adhesive forces, viscosity

18. Why does water "bead up" more on a car that is waxed than one that is not.

19. When a person has a severe fever, one therapy used to reduce the fever is an "alcohol rub". Explain how the evaporation of alcohol from a person's skin removes heat energy from the body.

20. a) Distinguish between crystalline solids and amorphous solids.
    b) Name and describe the 3 most common unit cells.
    c) Crystalline solids are classified according to the type of component that occupies the lattice points. What are the 3 classifications of crystalline solids?

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21. Classify each of the following according to the type of solid:
    a) Gold
    b) Carbon dioxide
    c) Calcium carbonate
    d) Krypton

22. Classify each of the following species as molecular, network covalent, ionic, or metallic.
    a) mercury
    b) iodine bromide
    c) sand
    d) chromium (III) sulfate
    e) chlorine gas

23. Consider the elements Al, Si, P, and S from the third period. In each case, identify the type of solid the element would form.

24. Of the four general types of solids, which one(s)
    a) are generally low boiling?
    b) are ductile and malleable?
    c) are generally nonvolatile?
    d) are generally insoluble in water?
    e) are very high melting?
    f) conduct electricity as solids?

25. Give the formula of a solid containing oxygen that is
    a) polar molecular
    b) ionic
    c) network covalent
    d) nonpolar molecular

26. Classify as metallic, network covalent, ionic, or molecular, a solid that
    a) melts below 100 ^{o}C and is insoluble in water.
    b) conducts electricity only when melted.
    c) is insoluble in water and conducts electricity.
    d) is insoluble in water, melts above 500 ^{o}C, and does not conduct electricity.
    e) dissolves in water but is nonconducting either as an aqueous solution, a solid, or molten.
    f) dissolves in water, melts above 100 ^{o}C, and conducts electricity when present in an aqueous solution.

27. Describe the nature of the structural units in
    a) NaI
    b) C_2H_2
    c) CO_2
    d) W
    e) C (graphite)
    f) $FeCl_2$

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28. Give the formula of a solid containing carbon that is
    a) molecular
    b) ionic
    c) network covalent
    d) nonpolar molecular

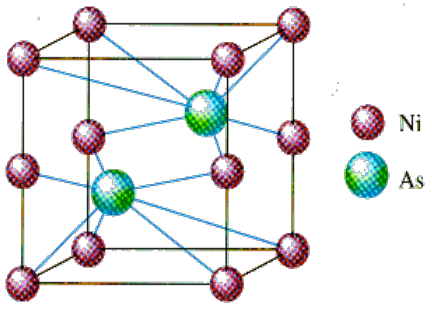
29. Calculate the number of atoms (or ions) in a cube of a
    a) simple cubic cell
    b) face-centered cubic cell
    c) body-centered cubic cell

30. For each of the following pairs, choose the substance you expect to have the lower vapor pressure at a given temperature, and explain your answer.
    a) CO_2 or SO_2
    b) dimethyl ether CH_3OCH_3 or ethanol

31. Associate each of the solids, BN, P_4S_3, Pb, and $CaCl_2$, with one of the following sets of properties.
    a) A bluish-white, shiny solid melting at 327 ^{o}C; the solid is soft and malleable.
    b) A white solid melting at 772 ^{o}C; the solid is an electrical nonconductor but dissolves in water to give a conducting solution.
    c) A yellowish-green solid melting at 127 ^{o}C.
    d) A very hard, colorless substance melting at about 3000 ^{o}C.

32. The structure of manganese fluoride can be described as a simple cubic array of manganese ions with fluoride ions at the center of each edge of the cubic unit cell. What is the charge of the manganese ions in this compound?

33. The unit cell for nickel arsenide is shown below. What is the formula of this compound?



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34. What does normal boiling point mean?

35. A particular refrigerator cools by evaporating liquefied dichlorofluoro-methane, CCl_2F_2. How many kilograms of this liquid must be evaporated to freeze a tray of water at 0 ^{o}C to ice at 0 ^{o}C? The mass of the water is 1050 g, the heat of fusion of ice is 6.01 kJ/mol, and the heat of vaporization of dichlorofluoromethane is 17.4 kJ/mol.

36. A 0.250 g piece of sodium metal is cautiously dropped into a mixture of 50.0 g of water and 50.0 g of ice, both at 0 ^{o}C. The reaction is

$$2Na\ (s)\ + H_2O\ (l)\ \longrightarrow\ 2NaOH\ (aq)\ + H_2\ (g) \qquad \Delta H\ = -368\ kJ$$

Will the ice melt? Assuming the final mixture has a specific heat capacity of 4.18 J/g·^{o}C, calculate the final temperature. The enthalpy of fusion for ice is 6.02 kJ/mol.

37. Methane, CH_4, reacts with chlorine, Cl_2, to produce a series of chlorinated hydrocarbons: methyl chloride (CH_3Cl), methylene chloride (CH_2Cl_2), chloroform ($CHCl_3$), and carbon tetrachloride (CCl_4). Which compound has the lowest vapor pressure at room temperature? Explain.

38. A substance has the following properties; sketch a heating curve for the substance starting at -50 ^{o}C.

		Specific Heat Capacities	
ΔH_{vap}	20.0 kJ/mol	C (s)	3.0 J/g·^{o}C
ΔH_{fus}	5.0 kJ.mol	C (l)	2.5 J/g·^{o}C
BP	75 ^{o}C	C (g)	1.0 J/g·^{o}C
FP	-15 ^{o}C		

39. a) Graph the following data to give a linear relation for vapor pressure as a function of temperature. **Calculate** the slope of the line to determine ΔH_{vap} for magnesium and lithium. (All values signifcant to the +/- 1)
    b) In which metal is the bonding stronger? Explain your answer.

Vapor Pressure (mm Hg)	**Temperature (^{o}C)**	
	Li	**Mg**
1	750	620
10	890	740
100	1080	900
400	1240	1040
760	1310	1110

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40. The difference between an interstitial alloy and a substitutional alloy is that in substitutional alloys
    a) some atoms of one element are replaced by atoms of another element.
    b) atoms of one element are inserted in the spaces between the atoms of the other element.
    c) atoms of one element fuse with the atoms of the other element.
    d) three elements, rather than two, are combined to form the alloy.

41. a) How do conductors and semiconductors differ as to the effect of temperature on electrical conductivity?
    b) How can an n-type semiconductor be produced from pure germanium?
    c) How can a p-type semiconductor be produced from pure germanium?

42. Calculate the amount of thermal energy necessary to change 10.0 g of ice at -15.0 ^{o}C to steam at 110.0 ^{o}C.

43. Arrange the following liquids, A, B, C, with vapor pressures, at room temperature of 88, 680, and 155, respectively, in order of decreasing boiling points.
    a) B>C>A b) A>B>C c) A>C>B d) C>A>B

44. Fill in the table for the classification of solids:

TYPE	STRUCTURAL UNITS	FORCES	PROPERTIES	EXAMPLES
			Low MP, BP Often gas or liquid at 25 ^{o}C. Nonconductors Insoluble in water More likely water soluble	H_2, CCl_4 HCl, NH_3
			High MP. Conductors in molten state or water soln	NaCl, MgO
			Variable MP. Good conductors in solid state. Insoluble in common solvents. Hard.	Na, Fe, Cu
			Very high MP. Hard. Insulators. Insoluble in common solvents.	C, SiO_2
			Very low MP Gases at 25 ^{o}C. Insulators	Ar