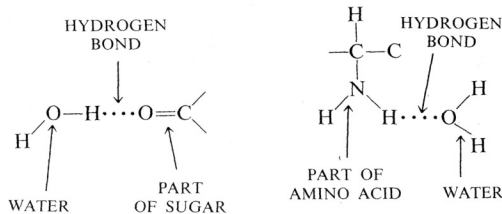
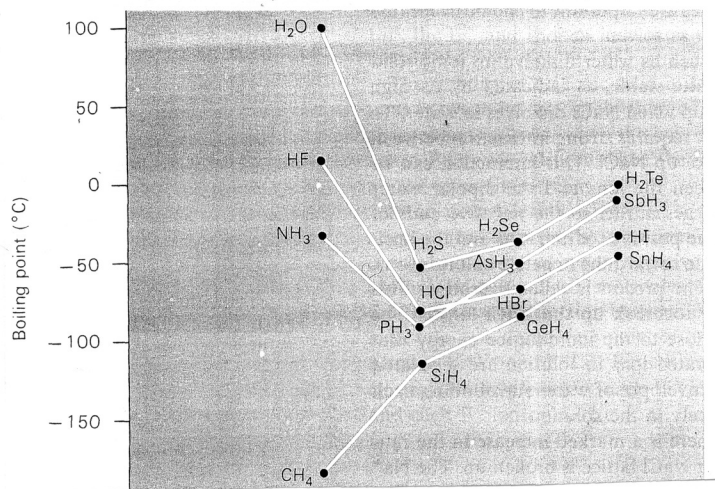


Old Chapter 13 Questions



QUESTIONS AND PROBLEMS

A

- (a) When we want to convert a gaseous substance to a liquid, we cool the gaseous substance and reduce its volume. Why? (*Hint*: consider the forces involved.) (b) Substances that obey the ideal gas law over a very wide temperature range, such as H₂, He, and so on, are usually very hard to liquify. Why?
- Differentiate between bonds that hold carbon and hydrogen together in methane, CH₄, and the "bonds" that hold methane molecules together in liquid methane (b.p. = -161 °C). Consider names, relative bond strengths, and electronic nature of linkages.
- (a) Which should have the higher boiling point, krypton or neon? Offer a reasonable explanation based on electronic models. (b) Consider the following facts: (1) Liquid propane (C₃H₈), which is used for torches, stoves, lanterns, and so on, is sold in steel tanks and when the valve is opened the propane vaporizes; (2) Gasoline (C₈H₁₀) can be handled in open cans, but a strong odor is detectable above the can and a spark gives a disastrous explosion and fire; (3) Lubricating oil (C₂₀H₄₂) can be handled in open cans, there is no odor above the oil, and a spark above the surface is harmless; (4) All three substances can be ignited by a direct flame. Explain in terms of the forces acting between molecules.
- A given hydrocarbon has the composition C₆H₁₄. There are several isomers with this composition. The first isomer (L) boils at 49 °C; the second isomer (H) boils at 69 °C. Suggest structural formulas for (L) and (H) that would be consistent with these facts.
- Diamond, a three-dimensional network solid, is a covalently bound substance that is the hardest material known. Diamond powder is a very effective abrasive. Graphite, another form of carbon, is used as a lubricant in locks, and so on. Explain these differences in the properties of graphite and diamond.
- Arrange the following compounds in order of increasing melting point: SnCl₄, SnBr₄, and SnI₄. Explain why each melting point of these compounds is different.
- Why is graphite a good lubricant for locks and talcum powder a good lubricant for the skin? Could you reverse these roles?
- (a) How could you determine experimentally whether a substance is a metal or a nonmetal? You should give at least four characteristics of metals as opposed to nonmetals. (b) Explain these key properties of metals in terms of electronic structure. For example, why is sodium a solid and chlorine a gas?
- Graphite is a good electrical conductor *along the planes*. In what way does the electronic structure of graphite resemble the electronic structure of a metal and in what way does it differ?
- (a) What characteristics of an atom, such as ionization energy, make it adopt the metallic structure? (b) Which element would have the higher heat of vaporization, K or Sc? Explain in terms of the electronic model.

B

- (a) Draw a body-centered cubic arrangement. (b) How many nearest neighbors does each atom have in a body-centered cubic arrangement? (c) What is a face-centered cubic arrangement? (d) How many nearest neighbors does each atom have in a face-centered cubic arrangement? (The face-centered cubic arrangement is also called the cubic close-packed arrangement.) (e) Why are these descriptions important in a study of metals?
- In order to dissolve an ionic solid in a liquid, the energy released when the lattice was formed must be provided. What process provides this energy when NaCl dissolves in water?
- Water boils at 100 °C and H₂S boils at -60 °C. Would we expect this trend for boiling points as we go down this vertical family in the periodic table if van der Waals forces were the controlling factor? Explain.
- Would you expect the boiling point of PH₃ to be above or below the boiling point of NH₃? Explain.
- Hydrogen bonds are extremely important in biology. Give one illustration of this point.
- Differentiate between and give examples of: (a) a molecular solid; (b) a three-dimensional network solid; (c) a two-dimensional network, or layered, solid; (d) a metal; and (e) an ionic solid.
- Describe several physical and/or chemical properties for each of your examples in problem 16.
- The electrical conductivity of solid silver is much better than that of molten AgCl. In turn, the electrical conductivity of molten AgCl is much better than that of solid AgCl. Explain these facts using appropriate models.
- Explain why a sharp blow with a hammer will deform a metal such as aluminum but will shatter an ionic crystal such as NaCl.
- Which type of bonding (van der Waals, covalent network solid, metallic, or ionic) is involved in each of the following substances: (a) He(l), (b) Fe(s), (c) diamond(s), (d) CH₄(g), (e) KCl(s), (f) Ag(s), (g) Si(s), (h) SiO₂(s), (i) I₂(g), (j) C₂H₂(l), (k) SO₂(l), (l) SiC(s), (m) MgO(s)?
- Describe the process by which ions of a solid such as NaCl go into solution when the crystal is placed in water.
- H₂SO₄ dissolves in water to liberate a large amount of heat. What are the forces that further this process?
- Explain why NaCl dissolves readily in water but very poorly in gasoline (C₈H₁₈) or benzene (C₆H₆).
- The compound CH₄ boils at -161 °C while H₃CF boils at -68 °C. Offer a reasonable explanation for these two facts.

C

- Unlike carbon, silicon does not form double bonds except under very special circumstances. Using this information, can you justify the fact that CO₂ is a gas but SiO₂ (quartz) is a hard solid with a high melting point?
- With reference to question 25, would a research project to prepare a graphite-like form of silicon have a very good possibility of success? Explain.
- You are given a sample of a white solid. Describe some experiments you can perform to help you decide whether the solid is held together by ionic bonds, covalent bonds, van der Waals forces, or metallic bonds.
- A silvery, shiny substance melts at -39 °C and boils at 357 °C. It is an excellent conductor of electricity. It is insoluble in water and has a vapor pressure of 1.7 × 10⁻³ mm at 25 °C. Do these data suggest that the substance is (a) a three-dimensional network substance, (b) a two-dimensional network substance, (c) an ionic substance, (d) a hydrogen-bonded liquid, or (e) a metal? Can you identify the material?
- Consider the successive elements sodium, magnesium, and aluminum. Considering sodium as the standard, copy the following table and fill in the blank spaces with *higher*, *lower*, *more*, or *less*, as appropriate.

	Sodium	Magnesium	Aluminum
ionization energy	XXX		
heat of vaporization	XXX		
metallic character	XXX		
hardness	XXX		