

Teacher's Tools[®] Chemistry Intermolecular Forces: Worksheet 6

1. Select the highest boiling member of each pair and indicate which ~~intermolecular~~ forces are involved.

- (A) NaCl or H₂O *electrostatic attraction vs H-bonding*
- (B) NH₃ or CH₄ *H bonding vs dispersion*
- (C) H₂O₂ or SiO₂ *network covalent vs H-bonding*
- (D) Ne or Xe *dispersion vs dispersion*
"more polarizable electron cloud" for Xe

2. Indicate the strongest attractive forces that must be overcome to

- (A) Vaporize Hg *metallic bonding*
- (B) Melt NaNO₃ *electrostatic attractions*
- (C) Boil C₃H₇OH *hydrogen bonding*
- (D) Dissolve CaCl₂ in H₂O
ionic attractions overcome by attractions of polar molecules for ions ("ion-dipole force")

3. State TRUE or FALSE accordingly and provide an explanation if false.

- (A) KBr is higher melting than SF₆. T *ionic vs. molecular*
- (B) C₂H₅OH is higher boiling than C₂H₅Cl. T *H-bond vs. dipole*
- (C) Dry Ice (solid CO₂) melts readily at room temperature. F *it sublimates, actually*
- (D) Iodine is more volatile than bromine. F *I₂ has stronger dispersion forces than Br₂*
volatile = easily evaporated

4. Classify each of the following as ionic, molecular (polar or nonpolar), network covalent, or metallic.

- (A) sodium *metallic*
- (B) SiO₂ *network covalent*
- (C) C₁₀H₈ *nonpolar molecular*
- (D) CaCO₃ *ionic*
- (E) titanium *metallic*
- (F) water *polar molecular*

Answer the following questions.

1. Consider calcium carbonate, CaCO₃.

- (A) What kind of compound is it? (network covalent, molecular ionic, metal)
- (B) What kinds of bonds are present in the solid? *electrostatic attractions*
- (C) When calcium carbonate is converted by heat to CO₂ and CaO (s), what bonds are broken? *ionic attractions and covalent bonds within CO₃²⁻ ion*
- (D) Compare its melting point to C (diamond) and CO₂. *lower than diamond, higher than CO₂*
- (E) What types of bonds are broken when calcium carbonate is dissolved in water?
electrostatic attractions

2. Consider the following data given for carbon tetrafluoride, CF₄, and phosphorus trifluoride, PF₃.

Compound	MM (g/mol)	No. of e-	Melting Pt (°C)	Boiling Pt (°C)
CF ₄	88	42	-184	-128
PF ₃	88	42	-152	-102

Explain why CF₄ has a lower melting point and boiling point than PF₃.

CF₄ - nonpolar molecule (polar bonds w/ dispersion force cancel in tetrahedral geometry)
PF₃ - polar molecule w/ dipole attractions

3. Of the four general types of solids, which one(s)

- (A) melt below 100°C to give a nonconducting liquid? *nonpolar molecular*
- (B) melt at moderate (100°C – 600°C) temperatures to give a conducting liquid? *metals*
- (C) melt at very high temperatures to give a conducting liquid? *ionic*
- (D) conduct electricity as a solid? *metal*
- (E) are very hard solids but dissolve readily in H₂O? *ionic*
- (F) are very hard solids that do not dissolve in common solvents? *network covalent*
- (G) dissolve in nonpolar solvents? *nonpolar molecular*

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Circle the correct answer(s).

1. The boiling point of ammonia (NH_3) is -33°C , while the boiling point of phosphine (PH_3) is -87.7°C . Ammonia has a higher boiling point because

- (A) the molar mass of NH_3 is less than that of PH_3 . *true - but not the reason*
- (B) dispersion forces for NH_3 are stronger than those for PH_3 . *false*
- (C) NH_3 is hydrogen bonded while PH_3 is not. *true & correct answer*
- (D) NH_3 is polar while PH_3 is not. *false*

2. Solid calcium chloride does not conduct electricity. When it is dissolved in distilled water, the resulting solution conducts electricity. Select plausible explanations for this change.

- (A) Like HCl , CaCl_2 is covalently bonded but becomes ionic when dissolved. *false*
- (B) It is the distilled water that conducts electricity; adding CaCl_2 has nothing to do with it. *false*
- (C) Since calcium loses 2e^- becoming Ca^{2+} , these electrons moving in the water conduct electricity. *false*
- (D) The ions in solid CaCl_2 are not free to move, but they are released and become mobile in solution. *true & correct answer*
- (E) All compounds with chlorine atoms have that property: non-conductor when solid, conductor when dissolved. *false*

3. In general, which properties are similar for network covalent and nonpolar molecular solids?

- (A) high melting points
- (B) nonelectrical conductors *- in other words, they don't conduct electricity*
- (C) insoluble in water
- (D) good thermal conductor
- (E) presence of covalent bonds *- inside molecules for nonpolar molecular solids throughout structure for network covalent*

4. Bromine, Br_2 , boils at 58.8°C , while iodine monochloride, ICl , boils at 97.4°C . The principal reason why ICl boils almost 40°C higher than Br_2 is that

- (A) the molar mass of ICl is 162.4 while that of Br_2 is 159.8.
- (B) ICl is an ionic compound while Br_2 is molecular. *False*
- (C) Dispersion forces for ICl are much higher than those for Br_2 . *false*
- (D) ICl is polar while Br_2 is nonpolar.
- (E) I and Cl are more electronegative than Br.

5. An ionic solid

- (A) does not conduct electricity. *- True - only if melted or dissolved*
- (B) is always soluble in water. *- usually - except for ppt exceptions*
- (C) can conduct electricity when the solid is melted. *yes*
- (D) can sometimes have some covalent bonds in its structure. *yes - if there are polyatomic ions as part of the crystal*
- (E) has an equal number of cations and anions.

ratio is not always 1:1
total pos = total neg