HW08 - IMFs, Liquids & Solids

Due Nov 6 at 5am **Points** 30 **Questions** 34 **Available** until Nov 6 at 5am
Time Limit None **Allowed Attempts** 3

Instructions

Homework 08 - IMFs, Liquids & Solids

Take the Quiz Again

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	669 minutes	18.5 out of 30

Correct answers will be available on Nov 6 at 5:01am.

Score for this attempt: **18.5** out of 30
Submitted Oct 30 at 10:25am
This attempt took 669 minutes.

Question 1

1 / 1 pts

Forces between particles (atoms, molecules, or ions) of a substance are called...

- (•) intermolecular forces.

  Bonds within molecules or formula units are called intramolecular forces. Bonds between particles are called intermolecular forces.

- ( ) None of these.
- ( ) armed forces.

intramolecular forces.

Question 2

1 / 1 pts

The dominant forces between molecules are...

- electrodynamic.
- magnetic.
- electromagnetic.
- gravitational.
- electrostatic.

Intermolecular forces are all electrostatic in origin.

Question 3

1 / 1 pts

Very weak and very short range attractive forces between temporary (induced) dipoles are called...

- cohesive forces.
- dispersion forces.

There are four types of intermolecular forces, listed here in order of decreasing strength: ion-ion interactions (which are so strong they can also be thought of a intramolecular forces), hydrogen bonding, dipole-dipole interactions, and dispersion forces. London forces, dispersion forces, van der Waals, or induced dipoles all describe the same intermolecular force. London forces are induced, short-lived, and very weak. Molecules and atoms can experience London forces because they have electron clouds. London forces result from the distortion of the electron cloud of an atom or molecule by the presence of nearby atoms or molecules.

- gravitational forces.
- adhesive forces.

Incorrect

Question 4

0 / 1 pts

Which of the following statements is NOT correct?

Dispersion forces...

- are the only forces between nonpolar molecules.
- are also called London forces.
- are temporary rather than permanent dipole-dipole interactions.
- decrease in strength with increasing molecular size.

Hint: Polarizability increases with increasing numbers of electrons.

Question 5

1 / 1 pts

Which of the following statements regarding intermolecular forces (IMF) is/are true?

1. IMF result from attractive forces between regions of positive and negative charge density in neighboring molecules.

2. The stronger the bonds within a molecule are, the stronger the intermolecular forces will be.

3. Only non-polar molecules have instantaneous dipoles.

- 2 only
- 1 and 3
- 1 and 2
- 2 and 3
- 3 only
- 1, 2, and 3
- 1 only

Statement 1 is true - all IMF result from Coulombic attraction. Statements 2 and 3 are both false; the strength of the bonds within a molecule have no bearing on the strength of the bonds between molecules; all molecules have London forces.

Incorrect

Question 6

0 / 1 pts

Which of the following structures represents a possible hydrogen bond?

- Br-H ····· Br
- F-H ····· F

C-H ····· O

Cl-H ····· Cl

Hint: H-bonds are a special case of very strong dipole-dipole interactions. They only occur when H is bonded to small, highly electronegative atoms (three in particular).

Question 7

1 / 1 pts

Which of the following interactions is generally the strongest?

dispersion forces

dipole-dipole interactions

ionic interactions

All molecules perform dispersion forces, intermolecular forces that appear and disappear due to instantaneous partial charges in molecules. Dipole-dipole interactions occur when a polar molecule contains permanent partial charges. Hydrogen bonding is a special type of dipole-dipole interaction that is stronger than most and occurs when hydrogen is specifically attached to either a N, O, or F atom. Even stronger than hydrogen bonding are ionic interactions that occur between atoms or molecules with full charges. These interactions are so strong, they can even be considered intermolecular forces as well as intramolecular forces. Thus, in order of strength (weakest to strongest), we have dispersion forces (aka London forces or van der Waals forces), dipole-dipole interactions, hydrogen bonding, and ionic interactions.

hydrogen bonding

Question 8

1 / 1 pts

What would be the most significant type of intermolecular forces in a liquid sample of fluoroform (CHF_3)?

- ionic
- dipole-dipole

  London forces, dispersion forces, van der Waals or induced dipoles all describe the same intermolecular force. London forces are induced, short-lived, and very weak. Molecules and atoms can experience London forces because they have electron clouds. London forces result from the distortion of the electron cloud of an atom or molecule by the presence of nearby atoms or molecules.

  Permanent dipole-dipole interactions are stronger than London forces and occur between polar-covalent molecules such as fluoroform here.

  H-bonds are a special case of very strong dipole-dipole interactions. They only occur when H is bonded to small, highly electronegative atoms - F, O, or N.

  Ion-ion interactions are the strongest due to extreme charge separation and occur between ionic molecules. They can be thought of as both inter- and intramolecular bonding.

  Covalent bonding is stronger than any of these, but they are specifically a type of intramolecular bonding, not intermolecular bonding.

  CHF_3 is a polar molecule that does not contain H bonds. Therefore, dipole-dipole forces will be the most significant type of intermolecular forces present.

- covalent
- hydrogen bonding
- dispersion

Incorrect

Question 9

0 / 1 pts

What is the predominant intermolecular force between IBr molecules in liquid IBr?

- hydrogen bonds
- dispersion forces
- ionic forces
- dipole forces
- covalent bonds

Hint: Sometimes the SIZE of atoms and molecules can influence the intermolecular forces involved more that the polarity of the bond.

Question 10

1 / 1 pts

What type of intermolecular forces would you expect to find in a pure liquid sample of carbon tetrachloride?

- London

  Carbon tetrachloride is nonpolar. Nonpolar molecules only exhibit London forces (aka dispersion forces) as their IMFs.

- interionic (ionic)
- dipole-dipole
- hydrogen bonding

Incorrect

Question 11

0 / 1 pts

Which of the following molecules are likely to form hydrogen bonds? Select all of the correct answers.

- [ ] CH_3COOH
- [x] CH_3OCH_3
- [x] CH_3CHO
- [x] CH_3CH_2OH

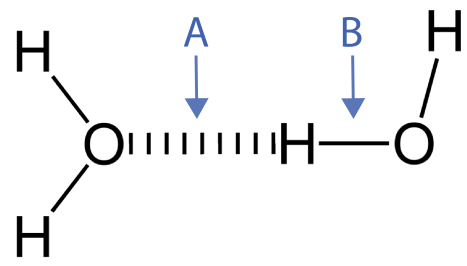
Hint: Only molecules with H attached to the electronegative atoms N, O, or F can hydrogen bond.

Incorrect

Question 12

0 / 1 pts

Consider the two water molecules below.



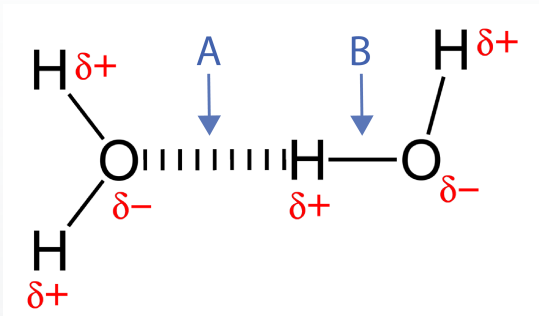
Which of the following statements is correct?

- ( ) The covalent bond B is weaker than the hydrogen bond A.
- ( ) The covalent bond B is stronger than the hydrogen bond A.

The covalent bond A is weaker than the hydrogen bond B.

The covalent bond A is stronger than the hydrogen bond B.

Hint:



Question 13

1 / 1 pts

Identify the kinds of intermolecular forces that might arise between molecules of N_2H_4.

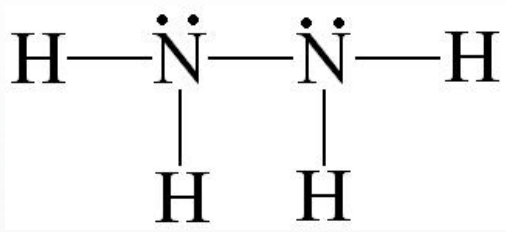
Dipole-dipole

London forces, dipole-dipole

London forces

London forces, dipole-dipole, and hydrogen bonding

The structure of N_2H_4 is shown below.



All molecules participate in London forces. N_2H_4, however, is also polar and can therefore also perform dipole-dipole interactions. In fact, the polar bonds shown connect hydrogen to a very electronegative atom, N. Thus, this molecule can also perform hydrogen bonding.

Hydrogen bonding

Incorrect

Question 14

0 / 1 pts

Which of the following is not correctly paired with its dominant type of intermolecular forces?

- C_6H_6 (benzene), instantaneous dipoles
- HBr, hydrogen bonding
- SiH_4, instantaneous dipoles
- NH_3, hydrogen bonding
- CaO, ionic forces

Question 15

1 / 1 pts

A drop of liquid tends to have a spherical shape due to the property of...

- viscosity.
- vapor pressure.
- close packing.
- capillary action.
- surface tension.

Molecules on the surface of a liquid are influenced by intermolecular attractions towards the interior; these attractions pull the surface layer towards the center. The most stable situation is one in which the surface area is minimal. For a given volume, a sphere has the least possible surface area. Thus, intermolecular forces cause the liquid to bead up, and we call this property surface tension.

Question 16

1 / 1 pts

Surface tension describes...

- the inward forces that must be overcome in order to expand the surface area of a liquid.

Molecules in the interior of a liquid interact with molecules all around them, whereas molecules at the surface of a liquid can only be affected by those beneath the surface layer. This phenomenon leads to a net inward force of attraction on the surface molecules, contracting the surface and making the liquid behave as though it had a skin. Surface tension is a measure of the inward forces that must be overcome to expand the surface area of a liquid.

- the resistance to flow of a liquid.
- adhesive forces between molecules.
- the forces of attraction between surface molecules of a solvent and the solute molecules.
- capillary action.
- the forces of attraction between the surface of a liquid and the air above it.

Question 17

1 / 1 pts

Predict which of butane (C_4H_{10}) or propanone (CH_3COCH_3) has the greater viscosity. Assume that they are both at the same temperature and in their liquid form.

- (•) propanone

  Propanone (aka acetone) should be more viscous than butane because it is more polar than butane.

- ( ) It's impossible to know.
- ( ) They have equal viscosities.
- ( ) butane

Question 18

1 / 1 pts

Which would you expect to be the most viscous?

- ( ) C_4H_8 at 30°C
- ( ) C_4H_8 at 50°C
- (•) C_8H_{18} at 30°C

  Viscosity increases as IMFs increase in strength and as the temperature decreases. C_8H_{18} would have higher IMFs than C_4H_8 since both are nonpolar molecules and larger molecules have greater dispersion forces. In addition, C_8H_{18} at 30°C would be more viscous than at 50°C.

- ( ) C_8H_{18} at 50°C

Incorrect

Question 19

0 / 1 pts

Based on the general concepts that govern intermolecular attractions, which of the following orderings of fluorocarbons is correct when going from highest to lowest boiling point?

1. CF_4
2. $F_3C\text{-}(CF_2)_4\text{-}CF_3$
3. $F_3C\text{-}(CF_2)_2\text{-}CF_3$

- 3, 1, 2
- 1, 3, 2

  Hint: All 3 molecules are non-polar, so their relative boiling points will be governed by the strength of their dispersion forces.
- 3, 2, 1
- 2, 1, 3
- 2, 3, 1
- 1, 2, 3

Incorrect

Question 20

0 / 1 pts

Tetrabromomethane has a higher boiling point than tetrachloromethane.

- True
- False

Hint: In general, the stronger the intermolecular forces, the higher the boiling point of the substance. Tetrabromomethane is CBr_4. Tetrachloromethane is CCl_4.

- It's impossible to know.

Question 21

1 / 1 pts

Which of KBr or CH_3Br is likely to have the higher normal boiling point?

- CH_3Br
- They will have the same boiling point.
- It is impossible to tell.
- KBr

KBr is an ionic compound as opposed to the molecular compound CH_3Br. As ionic interactions are stronger than dipole-dipole interactions, we expect KBr to have a higher boiling point. In fact, KBr boils at 1435°C and CH_3Br boils at 3.6°C.

Incorrect

Question 22

0 / 1 pts

Which of the following would you expect to boil at the lowest temperature?

- C_8H_{18}

Hint: Formulas with weaker intermolecular forces tend to have lower boiling points.

- KF
- PCl_3
- CH_4
- C_3H_6

Incorrect

Question 23

0 / 1 pts

The vapor pressure of all liquids...

- is the same at their freezing points.

  Hint: As kinetic energy increases, rate of evaporation increases and rate of condensation decreases.

- is the same at 100°C.
- decreases if the volume of the container increases.
- increases with temperature.

Question 24

1 / 1 pts

A liquid with a high vapor pressure is called...

- volatile.

  Easily vaporized liquids are called volatile liquids, and they have relatively high vapor pressures.

viscous.

cold.

hot.

Incorrect

Question 25

0 / 1 pts

Which would you expect to have the highest vapor pressure at a given temperature?

C_2H_6

SBr_4

NaCl

C_5H_{12}

Hint: To evaporate or change phase to a gas, liquids must overcome their IMFs. Therefore, substances with smaller IMFs tend to have higher vapor pressures.

Question 26

1 / 1 pts

Rank the following in order of increasing vapor pressure at a fixed temperature: H_2O, CH_3Cl, He, NaCl

$He < H_2O < CH_3Cl < NaCl$

$NaCl < H_2O < CH_3Cl < He$

Ordering these in terms of increasing vapor pressure is the same as ordering them in terms of decreasing IMF. This order is:

$NaCl < H_2O < CH_3Cl < He$

because NaCl is ionic, H_2O can perform hydrogen bonding, CH_3Cl is polar, and He is nonpolar.

- $H_2O < NaCl < CH_3Cl < He$
- $H_2O < CH_3Cl < He < NaCl$
- $He < CH_3Cl < H_2O < NaCl$

Question 27

0.5 / 0.5 pts

Put the following compounds in order of increasing melting points.

LiF, HF, F_2, NF_3

- F_2, NF_3, LiF, HF
- LiF, HF, NF_3, F_2
- **F_2, NF_3, HF, LiF**

  F_2 is nonpolar and will therefore have the weakest IMF. NF_3 is polar and will have dipole-dipole interactions, which are stronger IMFs. Stronger still is HF which can perform hydrogen bonding. Finally, LiF is ionic and held together by ionic interactions, the strongest IMFs of all. The stronger the IMFs holding molecules together, the more energy is required to separate the molecules and, thus, the higher the boiling point for the substance. So, the molecules listed in increasing order of IMF strength and, therefore, increasing order of boiling points are: F_2, NF_3, HF, LiF.

- LiF, HF, F_2, NF_3

Incorrect

Question 28

0 / 0.5 pts

Which of the following solids is a covalent network?

- $CaCO_3(s)$

  Hint: Calcium carbonate is an ionic solid.

- $H_2O(s)$
- $Ni(s)$
- $SiO_2(s)$

Question 29

0.5 / 0.5 pts

Which of the following, in the solid state, would be an example of a covalent crystal?

- water
- diamond

  Covalent crystals are held together by covalent bonds in an extended, rigid crystalline network. Diamond is a covalent crystal of carbon.

- carbon dioxide
- barium fluoride
- iron

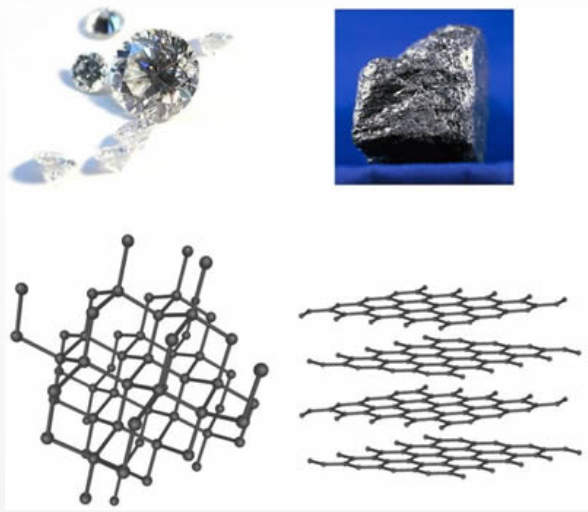
Question 30

0.5 / 0.5 pts

Diamond and graphite are two crystalline forms of carbon. In which form are the C atoms arranged in flat sheets with one C bonded to three nearby C atoms?

- neither of these
- graphite

Graphite forms flat sheets while diamond is tetrahedral.



- diamond

Question 31

0.5 / 0.5 pts

Which of the following, in the solid state, would be an example of a molecular crystal?

- carbon dioxide

CO_2 is a covalent molecule. Any extended lattice among covalent molecules will be held together by intermolecular forces. In this case, carbon dioxide is held together with dispersion forces and dipole-dipole interactions. Covalent bonds are not found between CO_2 molecules, only within the molecule. Therefore, the crystal will be molecular.

calcium fluroide

iron

diamond

Question 32

0.5 / 0.5 pts

Which of the following, in the solid state, would be an example of an ionic crystal?

diamond

carbon dioxide

sodium nitrate

Ionic solids have bonds between cations and anions. $NaNO_3$ is ionic:

$Na^+ + NO_3^-$

copper

Question 33

0.5 / 0.5 pts

Metallic solids are solids composed of metal atoms that are held together by metallic bonds. They also tend to be good conductors because...

metals are ductile and can be pulled into wires.

the electrons in metallic solids are tightly bound allowing other electrons to flow freely.

- metals are malleable and can be pounded into sheets.
- the electrons in metallic solids are delocalized.

While metals are ductile and malleable (able to be formed into wires or pounded into sheets), they are also good conductors because their electrons are delocalized to form a "sea of electrons" that allow electrecity (the movement of electrons) to flow freely.

Question 34

0.5 / 0.5 pts

Why is I_2 a solid while H_2 is a gas?

- I_2 has a larger dipole than H_2.
- I_2 is less polarizable than H_2.
- H_2 can perform hydrogen bonding.
- I_2 is more polarizable than H_2.

I_2 has significantly more electrons than H_2. In addition, those electrons are in orbitals that are significantly farther from the nucleus, making it easier to distort the electron cloud. In other words, I_2 is more polarizable than H_2. Higher polarizability leads to higher London dispersion forces. Neither molecule has a dipole nor can they perform hydrogen bonding.

Quiz Score: **18.5** out of 30