

Organic and Intermolecular forces Test Review!!!!

1. a. Draw each compound. b. Identify any geometric or structural isomers.
c. For any isomer pairs, which isomer would have the higher boiling point? Why?

ethanoic acid

cis-1,2 dichloro ethene

trans-1,2 dichloro ethene

an ester with two total carbons

ethanol

2. Draw each compound:

2-propanol

1-propanol

propanone

propanal

propyl amine

dimethyl amine

an amide with 2 total carbons

2 possible isomers for an ester with 3 total carbons

cyclopentanol

2-pentyne

diethyl ether

1,3 difluorobenzene

3. Of the compounds in #1 and #2,

-which are acidic? basic? neutral?

-which compounds can hydrogen bond with other molecules of their own kind?

-which compounds can hydrogen bond with water?

-ID the IMF type in each compound.

4. Consider the compounds pentanal and hexane.

a. Draw each compound.

b. At a given temperature, which compound has a higher...

solubility into water?

boiling point?

viscosity?

surface tension?

vapor pressure?

cohesive forces?

ability to have "capillary action"?

5. Consider propanoic acid, butanoic acid, and pentanoic acid.

Which is most soluble into water?

Which has the highest boiling point?

6. What types of forces are present between solute and solvent particles in each case?
(Draw a picture and label the forces present in the solution.)

when calcium nitrate dissolves into water?

when methanol or methyl amine dissolves into water?

when propanone (acetone) dissolves into water?

when formaldehyde (methanaldehyde) dissolves into propanone (acetone)?

when benzene dissolves into hexane?

when ammonium chloride dissolves into water?

7. Consider the elements B, Sn, and Pb.

a. Identify a pair of elements (from this list) could mix together to form a substitutional alloy.

b. Identify a pair of elements (from this list) could mix together to form an interstitial alloy.

8 a. Rank these from best (#1) to worst (#4) in terms of electrical conductivity.

pure Ge

Ge doped with P

Fe

I₂

b. When Germanium is doped with Phosphorus, does this make a p-type or n-type semiconductor? Explain.

c. What could Ge be doped with to make the other type of semiconductor? Explain.

d. Determine the intermolecular force present in each of the three elements listed in part (a).

9a. What is the hybridization of carbon and the approximate C-C-C bond angle in each of these?

nanotubes

diamond

graphite

buckyball/fullerene

b. which of these can conduct electricity? _____

c. which of these can dissolve in water? _____

d. which of these could dissolve in nonpolar solvents, like benzene? _____

e. Silicon has the same structure and hybridization as the carbon atoms have in _____.

- 10a.** Sketch each of the substances below to show the structure/arrangement.
b. Classify each substance as a conductor, semiconductor, or non conductor.
c. Identify the types of “IMF” in the first four substances.

Silicon_(s)

NaCl_(s)

MgCl_{2(aq)}

A substitutional alloy of Cu and Os

Steel (an interstitial alloy)

10. Sig Figs! In this problem you will write a Petrarchian Sonnet about significant figures. Your rhyme scheme in the octave/octet must be ABBAABBA. Your sestet rhyme scheme must be CDDECE. To receive full credit, your sestet must solve the problem that you presented in the octave, and lines 4, 5, and 6 of the sestet must also be a 5-7-5 Haiku. Be prepared to perform your sonnet to the key of E sharp with a 13/7 time signature. Please use your best “inward singing” voice while performing the alto and soprano vocals simultaneously. Do NOT use scientific notation - that’s just tacky.

11. Substance	Boiling Point (°C)	Solubility in water (moles compound per 100 g H ₂ O)
1-propanol	_____	_____
1-butanol	_____	_____
1-pentanol	_____	_____
1-hexanol	_____	_____

a. These four liquids have boiling points of 97, 157, 138, and 117 (celsius) and solubilities of 0.0058, 0.11, miscible, and 0.030. Use this data to fill in the table, above.

b. If each of the liquids are at room temperature,
 Which liquid would have the highest vapor pressure? _____
 Which liquid would have the highest solubility into carbon tetrachloride? _____

c. Propylene Glycol (1,2-propanediol; C₃H₆(OH)₂) has a similar molar mass to butanol. How would you expect propylene glycol and butanol to compare in terms of viscosity, boiling point, and vapor pressure?

d. Fullerenes/Buckyballs are slightly soluble in some solvents. Which of the four liquids in the chart would be the best solvent for fullerenes? _____

12. Sketch the following molecule to show all the bonds, atoms, and lone pairs.

- Determine the ideal bond-to-bond angle around each carbon and oxygen.
- Determine the hybridization of each carbon and oxygen.
- Determine the total number of pi bonds in the molecule.
- Does this molecule have the possibility of geometric isomers? Why/why not?
- Is this compound saturated? Why/why not?



13. For each pair of compounds, circle the compound with the stronger intermolecular force/higher melting point/higher boiling point.

ethanal or ethanol

C_8H_{18} or $C_7H_{15}OH$

Diamond or Tin

KNO_3 or K_2O

H_2O or SiO_2

hexane or nonane

$NaOH$ or CH_3OH

magnesium or graphite

CH_3OH or Kr

$AgCl$ or CuS

C_3H_7OH or $CH_3-O-CH_2CH_3$

$CH_3CH_2CH_2CH_2-O-CH_2CH_3$ or $CH_3-O-CH_2CH_3$

CF_4 or Cl_4

H_2O or CH_4

13 cont'd. For each pair of compounds, circle the compound with the stronger intermolecular force/higher melting point/higher boiling point.

H₂O or MgSO₄

H₂O or Zn

butanone or butanol

H₂O or SiC

I₂ or SiC

FeO or RbCl

Mg(OH)₂ or C₂H₄(OH)₂

methyl amine or ethyl amine

Co or CO

propane vs ethylamine

Si vs Ar

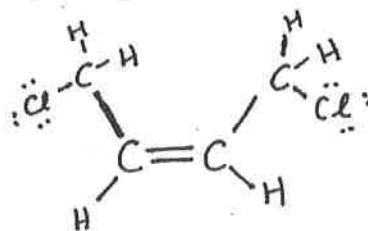
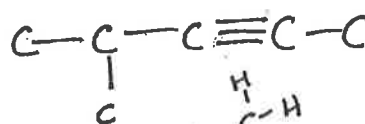
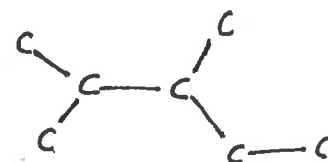
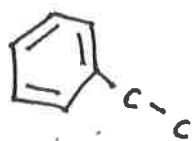
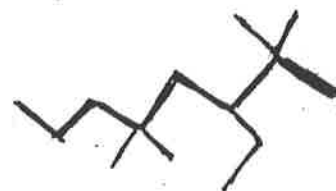
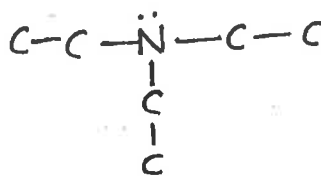
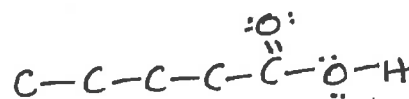
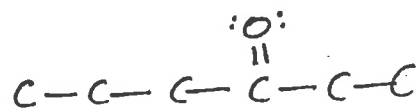
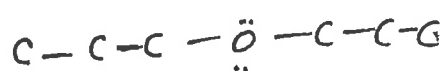
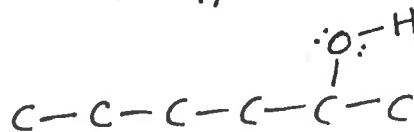
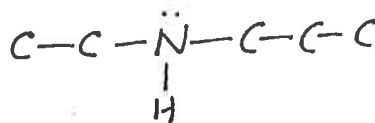
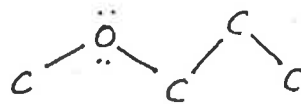
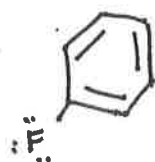
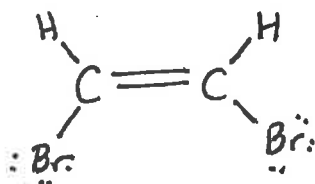
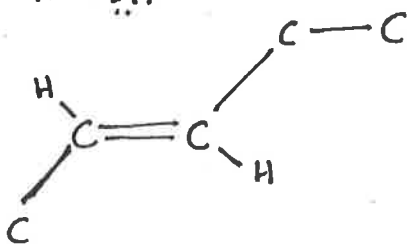
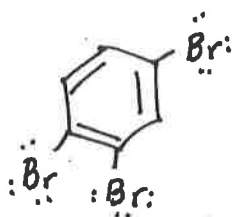
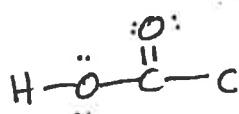
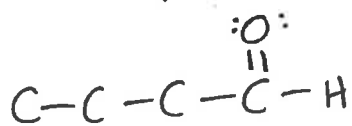
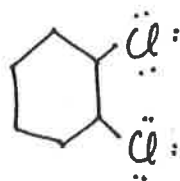
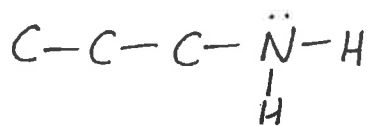
C₄H₁₀O vs C₁₀H₂₂O

BaSO₄ vs BaO

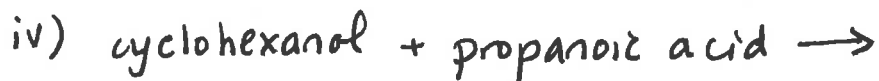
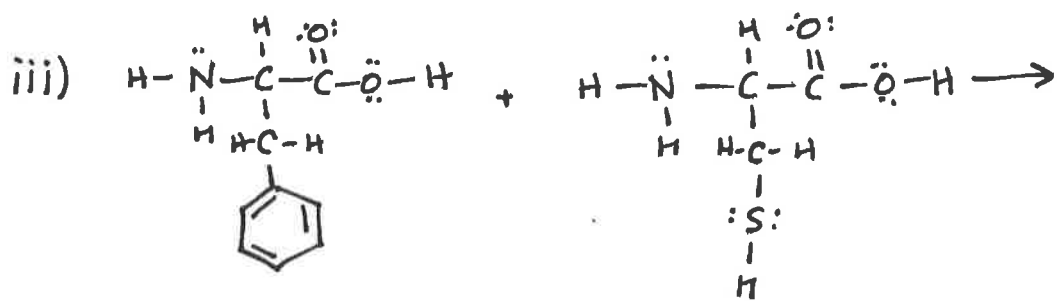
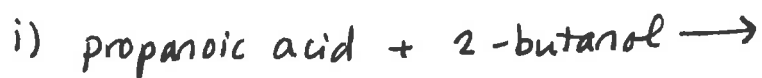
C₅H₁₂ vs C₄H₁₀

C₅H₁₂ vs Ge

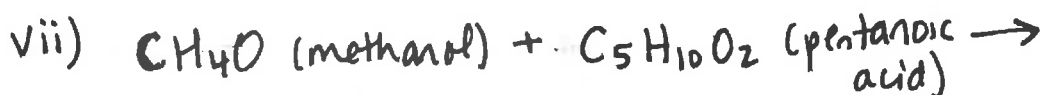
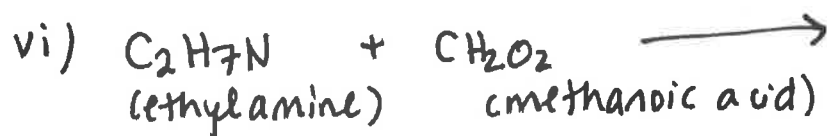
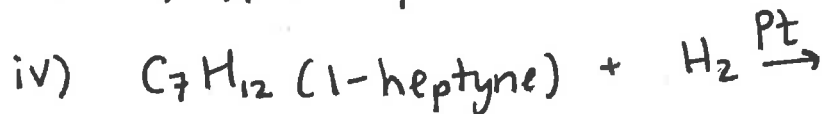
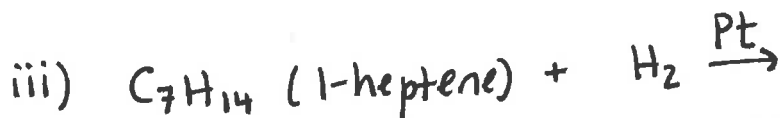
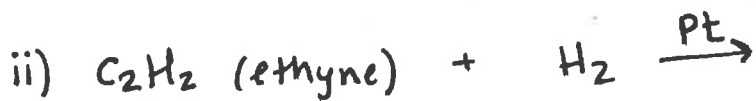
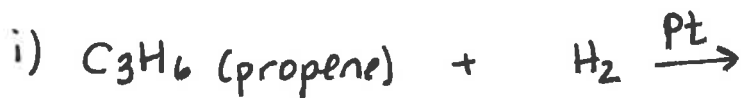
14. Name each compound!



a) Draw the product(s) for each reaction:



b) Complete and balance each reaction



16. Distillation.

Consider the compounds 1-hexanol ($C_6H_{14}O$) and 1-tetradecanol ($C_{14}H_{26}O$).

Suppose that a 50/50 mixture of these liquids is placed into a flask and heated, so that the mixture boils.

a. Which compound will be more prevalent in the vapor? Why? Explain in terms of intermolecular forces.

b. The vapor is run through a condenser and then drips into a collection flask. Which compound will be more prevalent in the collection flask?

Now consider the compounds hexane (C_6H_{14}) and 1-pentanol ($C_5H_{12}O$).

Suppose that a 50/50 mixture of these liquids is placed into a flask and heated, so that the mixture boils.

c. Which compound will be more prevalent in the vapor phase? Explain in terms of intermolecular forces.

d. After the mixture has been boiling for a while, which liquid will be more prevalent in the original flask?

17. Consider the compounds carbon tetrachloride and methanol.

a. Draw the complete dot structure for each compound, including geometry, and classify the compound as polar or nonpolar.

b. A large testtube is filled about halfway with carbon tetrachloride and then filled the rest of the way with methanol. The liquids form 2 distinct layers with the carbon tetrachloride on the bottom. A mixture of two compounds ($C_3H_6O_3$ and $C_8H_{18}O$) is added to the testtube and the mixture is shaken up so that the two compounds can dissolve. Which compound will dissolve into which layer/liquid? Explain.

A sample of the mixture from part b ($C_3H_6O_3$ and $C_8H_{18}O$) is placed on some chromatography paper and the paper is placed in a beaker containing solvent at the bottom. The solvent travels up the paper, taking the compounds with it.

c. Which compound ($C_3H_6O_3$ or $C_8H_{18}O$) will travel further up the paper if the solvent is hexane? _____

d. Which compound will travel further up the paper if the solvent is water? _____

Test Topics for the "Organic and Intermolecular Forces" unit:

Organic Chem - Nomenclature

A chart of prefixes will be given (meth-, eth-, prop-, but-, and mono-, di-, tri, ...)

Be able to identify all functional group types (see page 2 of In-class practice set #1 for a list)

Be able to draw (if given the name) or name (if given a picture) all functional groups except esters and amides

Identify hybridization and bond angles of C/N/O atoms in a compound. Count sigma and pi bonds.

Structural isomers – what are isomers? be able to draw different isomers of compounds.

Geometric isomers (cis and trans)

Identify functional groups as acidic or basic when dissolved in water:

Amines are basic, acids are acidic (!), and assume that others are neutral.

Saturation: What does it mean for an organic compound to be "saturated" or "unsaturated?"

Organic Chem - Reactions: Be able to predict products for these reaction types:

alcohol + acid -----> ester + water

amine + acid -----> amide + water

alkene or alkyne + H₂ -----> alkane (at high T and P_{H₂}, and a Pt/Pd/Ni catalyst.)

Amino acids: Given the structure, connect them to form a polypeptide/protein, and classify the side chain as hydrophobic or hydrophilic.

Polarity and Like dissolves like:

Know that C-H and C-C bonds are nonpolar.

Know that C-N, N-H, C-O, O-H, C-F, and C-Cl are polar.

Will a compound dissolve into water? Hexane? Neither?

Will a compound be water soluble vs fat soluble?

Compare organic compounds and rank them according to solubility into water or another solvent.

Compare organic compounds and rank them according to mp/bp/IMF strength.

Intermolecular Forces

Be able to identify the main Intermolecular force (IMF) present in a compound, element, or mixture.

Be able to rank substances by IMF strength/melting point/boiling point.

Be able to discuss/compare substances in terms of:

Electrical conductivity, hardness, flexibility, structure on an atomic/molecular/ionic level, phase at room temperature, viscosity, surface tension, capillary action, vapor pressure, cohesion, adhesion.

Covalent Network Solid > Ionic > Metallic >> H-bonding > Dipole-Dipole > London Dispersion

(and Ion-Dipole Forces, which overlap with H-bonding and Dipole Dipole forces)

For ionic bonding:

Higher ion charges ----> stronger forces

Smaller ionic radii ----> stronger forces

(charge matters more than radius)

For H-bonding, Dipole-Dipole, and London Forces, the substances exist as **molecules**.

For a given polarity: Larger molecule ---> stronger forces

For a given size of molecule" More polar ---> stronger forces

Why do larger molecules generally have stronger London Forces? Give two reasons.

(Cont'd on back)

Intermolecular Forces, Continued:

What types of forces are present between solute and solvent particles in a solution?

For example, what types of forces are present...

when calcium nitrate dissolves into water?

when methanol or methyl amine dissolves into water?

when propanone (acetone) dissolves into water?

when formaldehyde (methanaldehyde) dissolves into propanone (acetone)?

when benzene dissolves into hexane?

when ammonium chloride dissolves into water?

Silicon and Carbon:

Be able to identify and/or list 4 different allotropes of carbon (diamond, graphite, buckyballs/fullerenes, nanotubes)

Know the basic structure of diamond, and that each carbon is sp^3 hybridized, with C-C-C angles of 109.5°

Know the basic structure of graphite, and that each carbon is sp^2 hybridized, with C-C-C angles of 120°

Know the basic structure of nanotubes and buckyballs, and that each carbon is sp^2 hybridized,

with C-C-C angles of approximately 120° .

Know that graphite, nanotubes, and buckyballs can conduct electricity, and why/how.

Know the basic structure of silicon, and that each carbon is sp^3 hybridized, with Si-Si-Si angles of 109.5°

Alloys:

What is an alloy?

Substitutional alloys vs Interstitial alloys vs Intermetallic compounds

Given the atomic radii of two elements, which type of alloy is more likely to form? why?

How do substitutional alloys often differ from interstitial alloys in terms of flexibility?

Semiconductors:

Know that metals are good conductors of electricity, nonmetals (except graphite) are poor/non conductors of electricity, and that Si and Ge are semiconductors.

For example, how do Copper, Silicon, and Sulfur compare in terms of conductivity?

Explain, in terms of position on the periodic table. How does this relate to ionization energy?

Doping – what is it, and how does it affect conductivity?

n-type doping. What type of element will work, if you are doping Si or Ge? Why/how does this increase conductivity?

p-type doping. What type of element will work, if you are doping Si or Ge? Why/how does this increase conductivity?