

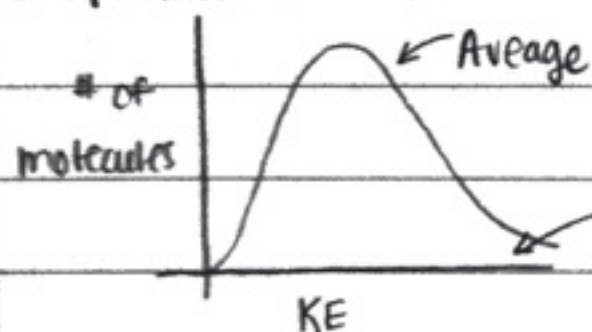
- Molecular solids - solids essentially collections of molecules held together by IMF
- solid structure - maintained by IMFs rather than bonds (metallic, covalent, ionic)
- Forces holding solid together much weaker than for any other types of solids so these materials have much lower melting points
- Covalent solids also have localized electrons (localized w/in each molecule) and as such, do not conduct electricity
- Ex: Ice (solid water), CO_2 Dry ice, solid iodine, and naphthalene

- SOLIDS

- viscosity is resistance to flow. High viscosity is slow moving
- Vapor pressure - what is relationship between boiling point and vapor pressure?
 - low boiling point - high vapor pressure - weak IMF - low viscosity - low surface tension
 - High boiling point - low vapor pressure - strong IMF - high viscosity - high surface tension
 - boiling point is the temperature where the vapor pressure = 1 atm

Which of the following has the highest vapor pressure? CH_3OH ← all molecules have IMF, but larger molecules have more dispersion forces.

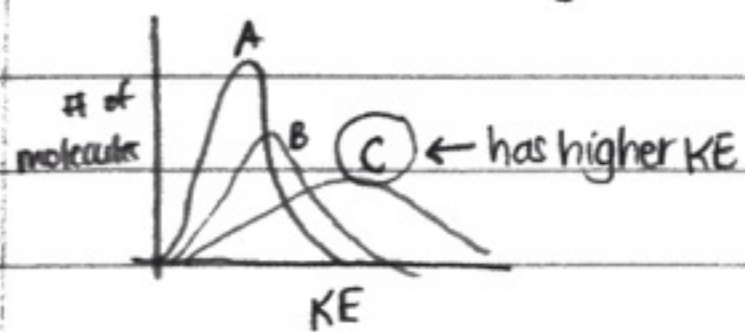
Evaporation - Boltzmann distribution explains evaporation



if there is enough KE then it has enough energy to escape the bonds holding it so it will leave the liquid and evaporate.

extremely high energy. more than enough energy to escape bond, so it leaves the liquid.

Which distribution is at higher T?



Temperature is a measure of average KE

- more KE, means its easier for molecules to escape the liquid and evaporate

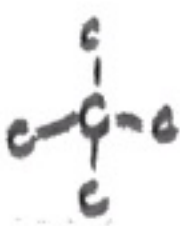
[As $T \uparrow$ $VP \uparrow$ (non-linear)]

increasing temperature the effect of IMF molecules are moving faster

What will happen to viscosity as the temperature increases? It will go down because there is more KE at high temperature so molecules slide past each other easier

- Physical Properties

- Properties of liquids based on intermolecular forces and SHAPES of molecules
- Properties of solid based on IMF and the TYPE of bonding - classify by types of bonding
- Before we had discrete molecules. Now we have substances that can't be described by discrete molecules bc they may keep on going on.

- Diamond has all sp^3 orbitals  that are bonded together in a tetrahedral network, making it hard, no plane to cut through.

- Graphite is a bunch of C molecules held together by dispersion forces and a bunch of C atoms covalently bound together:

↳ it is composed of sheets. The sheet itself is made of covalent bonds.

↳ the sheets held together by dispersion

↳ sp^2 carbon

↳ delocalized electrons because of the pi bonds



- Covalent solids should be called NETWORK SOLIDS.

- Molecular solids - IMF, Lewis structures, when they evaporate, molecules come off.

- Types of solids:

- Ionic - metals + non metals

- covalent or network - has covalent bonds that keep going. COVALENT BONDS stronger and holds the together.

- molecular - molecules held together by IMF. when melts, it breaks IMF, NOT individual bonds. Easier to melt bc not as strong as covalent bonds.

- metallic: all metals - very delocalized electrons - electrons shared throughout - sea of electrons.

- Types of solid

ionic Hard, rigid, brittle; high melting / boiling points; those soluble in water give conducting solution

Unit 3 Solids

• HW 09 due TUES. 9 AM

Clicker Question

- Viscosity is...
 - resistance to flow
 - high viscosity = really slow

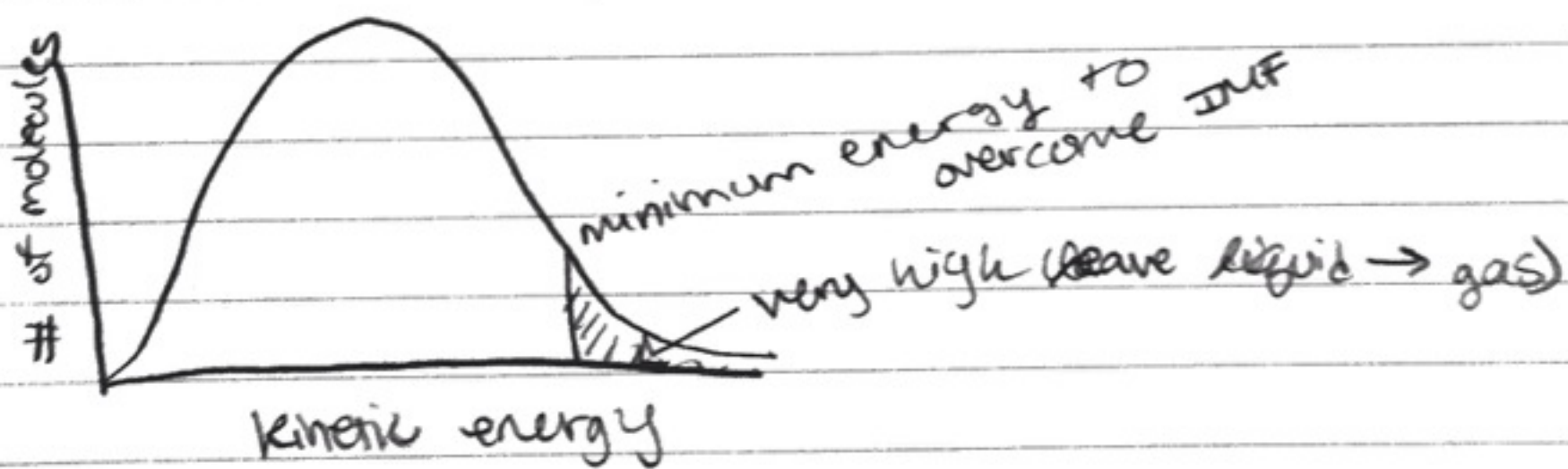
Vapor Pressure

- relationship between boiling pt & vapor pressure
 - strong IMF, low VP, high BP
 - weak IMF, high VP, low BP
- B.P. temp. V.P. = 1 atm

Which of the following has the highest vapor pressure?
□ CH_3OH (low dispersion forces)

Evaporation

- Boltzmann distribution explains evaporation



- higher K.E., higher temp.
- temp. is a measure of avg. K.E.

What do you think will happen to the viscosity as the temp is increased?

- It will go down

Physical Properties of Liquids

- based on IMF and shapes of molecules
 - strong IMF ↓ VP, high viscosity, high surface temp
 - weak IMF ↑ VP, low viscosity, low surface tension

Properties of Solids

- based on IMF and the TYPE of bonding
- Diamonds are...
 - a bunch of C atoms covalently bound together
- before, we had discrete molecules
- diamond is carbon with sp^3 hybridization
- Graphite is...
 - a bunch of C atoms, held together by dispersion forces and covalently bound sheet
 - all C are sp^2 hybridization
 - delocalized e^-
 - Sheets held together in a layer (covalent)
 - sheets held with sheets (IMF)
- molecular solid - discrete object
- we have discussed molecular and ionic
 - Lewis structure, intermolecular forces, ionic solids

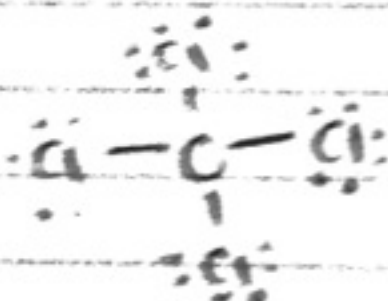


Types of Solids

- Ionic - ions; metals & nonmetal
- Covalent (network solid) - keep going (no end); held by covalent bonds
- molecular - look at each molecule and see how they're held together
 - easier to melt
 - overcome IMF
- Metallic - all metals; very delocalized electrons; sea of electrons
 - much easier to change shape

Ex CCl_4

- molecule
- covalently bonded together
- tetrahedral
- polar bonds / nonpolar molecule
- liquid @ RT
- IMF - only dispersion forces
- 4 Cl, relatively strong dispersion



Resistance of flow:

Viscosity: Molecular weight and shape both affect the viscosity of the liquid

Water penny sinks faster

Motor oil

corn syrup penny sinks slowly

04.31 HALLOWEEN!

Boltzmann distribution explains evaporation



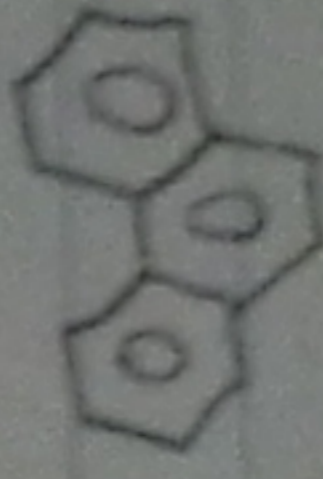
At higher temperature the faster evaporation
vapor pressure = 1 atm \rightarrow boiling point
vapor pressure dependent of temp.

Physical Properties

- Properties of liquids: based on IMF and shapes of molecule
- Properties of Solids:

continuous

diamonds are covalently bonded together
graphite is made of carbon but different shape.



Solids are classified into four different categories

Ionic

covalent huge network of atoms connected together, very strong

Metallic

Molecular a solid composed of discrete molecules, very weak

difference is boiling point

1. Potassium chlorate ($KClO_3$) MP = 629 K, BP = 673 K

- ionic compound

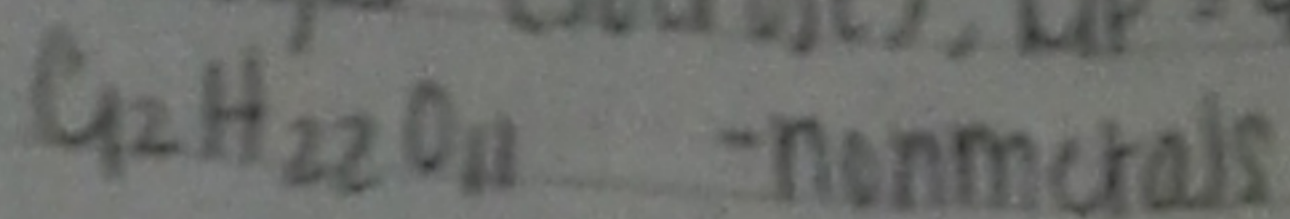
- ionic solid

- solid at room temp

MP > T_{room} BP > T_{room}

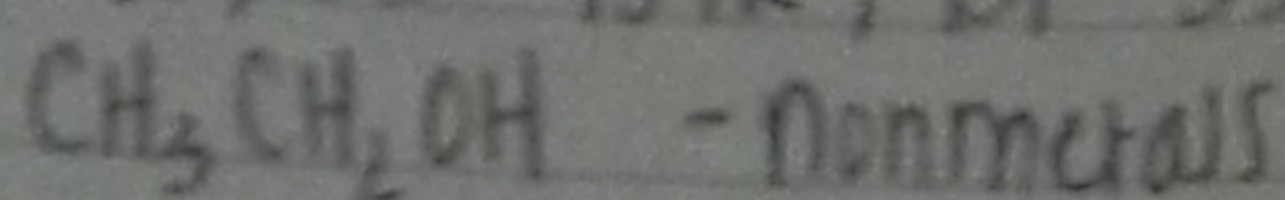
ROOM
TEMP
298K

2. Table Sugar (sucrose), MP = 459 K, BP = NA



- most likely molecular compound that would need to be held in condensed phase w/ IMFS

3. Ethanol, MP = 159 K, BP = 351 K



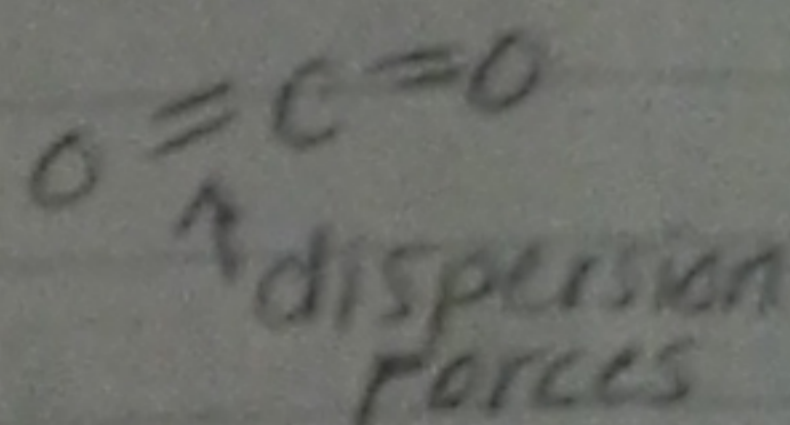
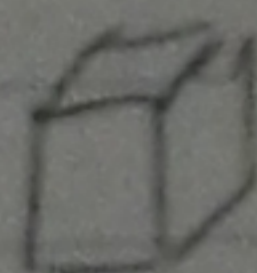
example: CO_2

at room temp: gas

Solid: Dry Ice, white solid

Molecular solid - low melting point
made of discrete CO_2

dispersion forces



induced-dipole -
induced-dipole

Metallic Solid has delocalized electrons

Gas, Liquid, Solid Cont.

- Higher vapor pressure \rightarrow more of the molecule in the surrounding air
- Strong IMF leads to more P.E.
- Once high energy molecules leave, it "takes heat with it"
- Increasing temp \rightarrow decrease viscosity

Properties of liquids based on IMF/shapes of molecules

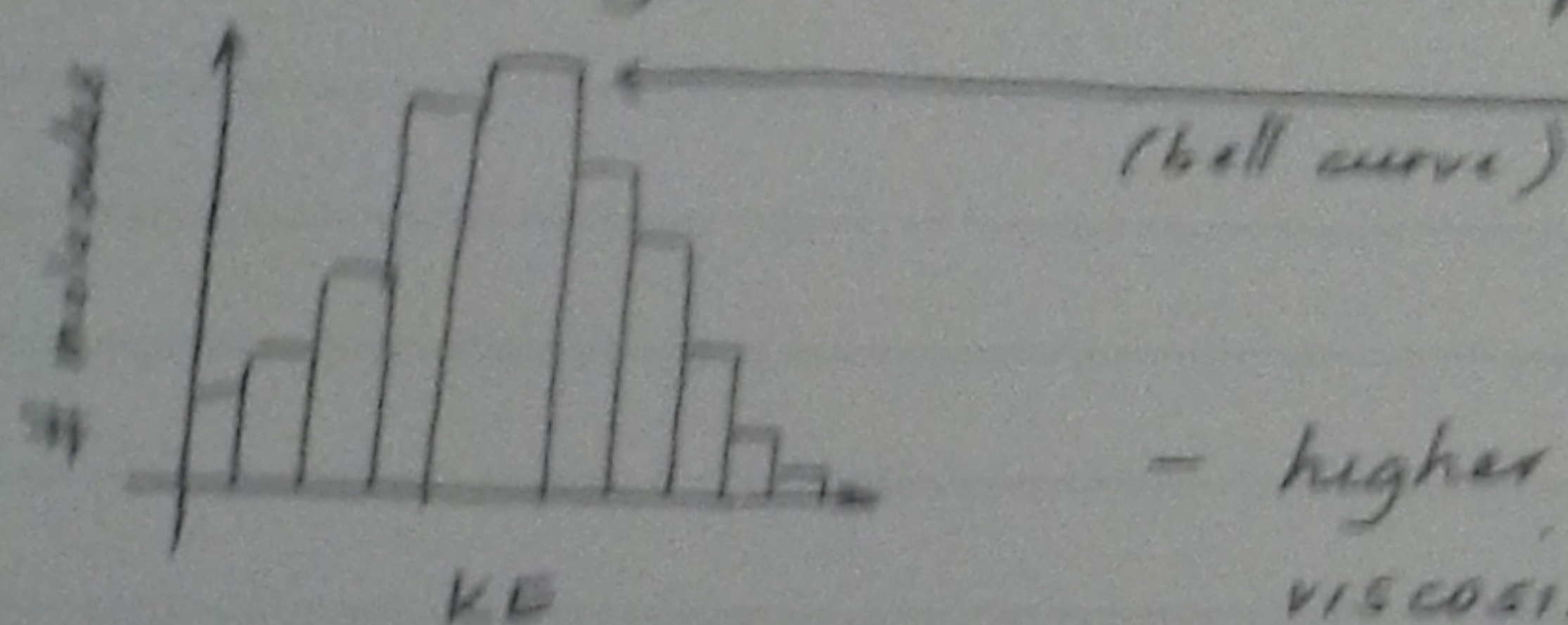
Properties of solids based on IMF / bonds

- Diamonds are sp^3 hybridized, graphite is sp^2 hybridized with benzene rings
- Both localized and delocalized electrons in graphite
- Molecular solid - Held with IMF, low melting point
- Covalent - Network, high melting point

PROPERTIES OF LIQUIDS & SOLIDS

10/31/2013

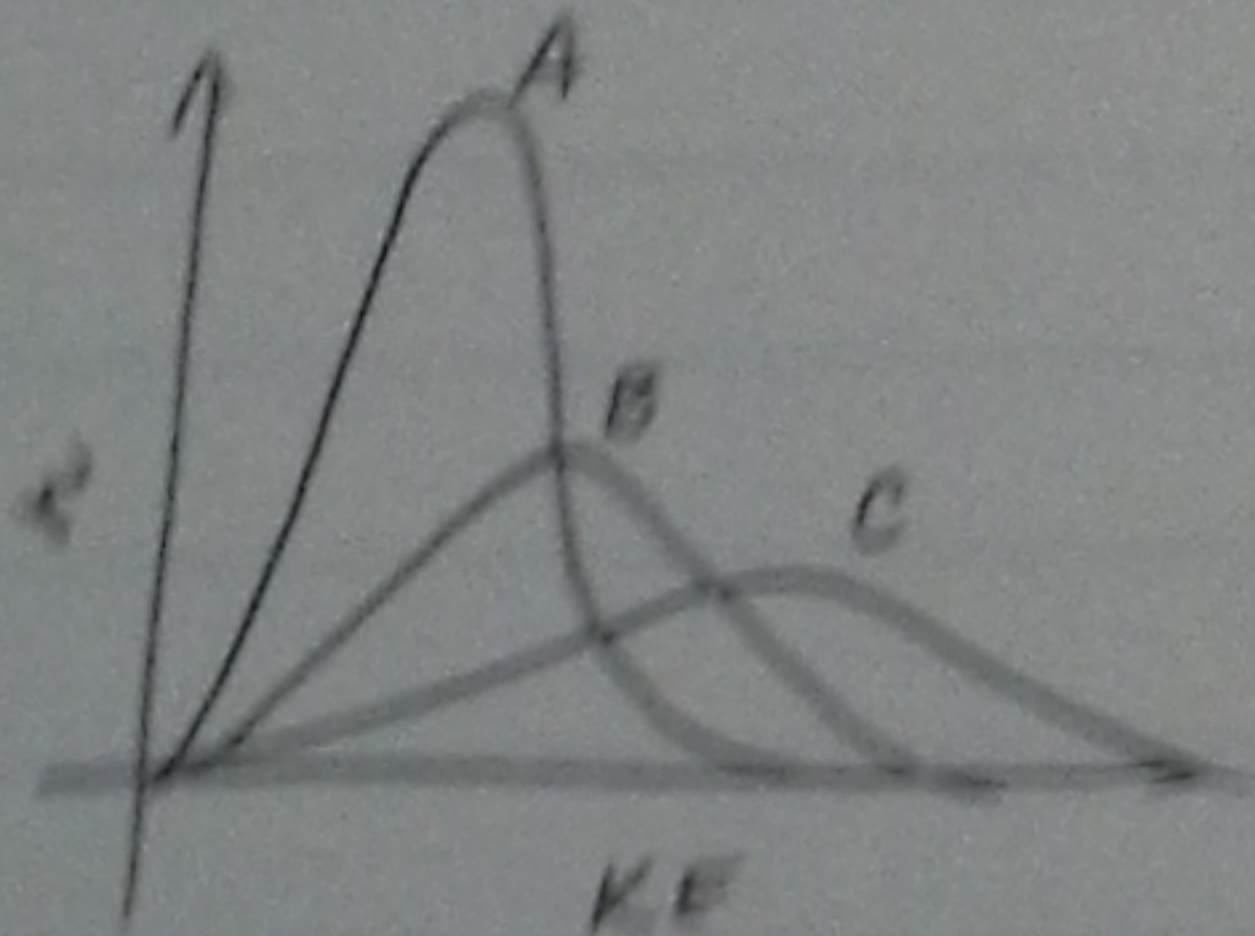
- Vapor pressure is a measure of gas concentration
 - \uparrow vapor pressure, lower boiling point
- evaporation explained by Boltzmann distribution
 - distribution of KE at any temperature
 - > w/ solids, consider vibrational movmt
 - > w/ liquids, at a certain KE, ^{there} are a max # molecules
 - > stronger the IMF, ^{higher} ~~strong~~ potential energy



- higher temperature \rightarrow decreased viscosity

CQ1

Which distribution is at higher temperature?



As your distribution shifts, your substance is subjected to higher KE

• In addition vapor pressure is directly related to temperature until vapor pressure is 1 atm \rightarrow boiling point

- properties of liquids dpt on IMF and shape of molecules
- properties of solids dpt on bonding
- graphite vs. diamonds
 - both ~~held by~~ composed of C atoms covalently bonded
 - graphite \leftarrow also dispersion forces btwn atoms

TYPES OF SOLIDS

- ionic
- metallic
- network/covalent
- molecular