

Gas, Liquid or Solid

UNIT 3 DAY 7

Important Information

HW9 due Tuesday 9 am.

What are we going to do today?

Think about properties of solids.

Review properties of liquids in context of IMF.

Physical Properties

Properties of Liquids

- Based on intermolecular forces.

Properties of Solids

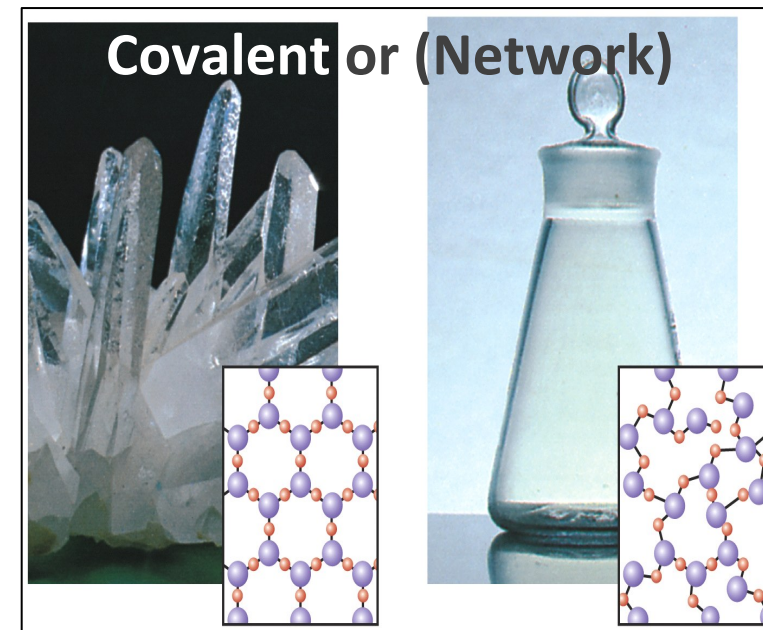
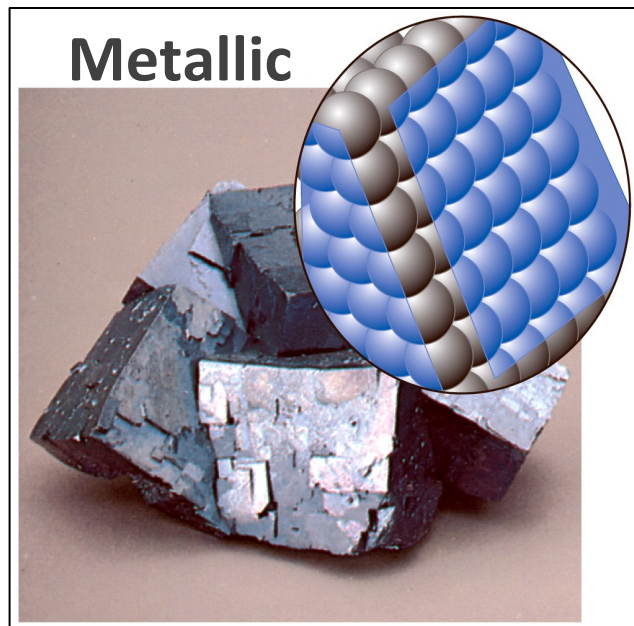
- Based on intermolecular forces and the **type** of bonding.

Question

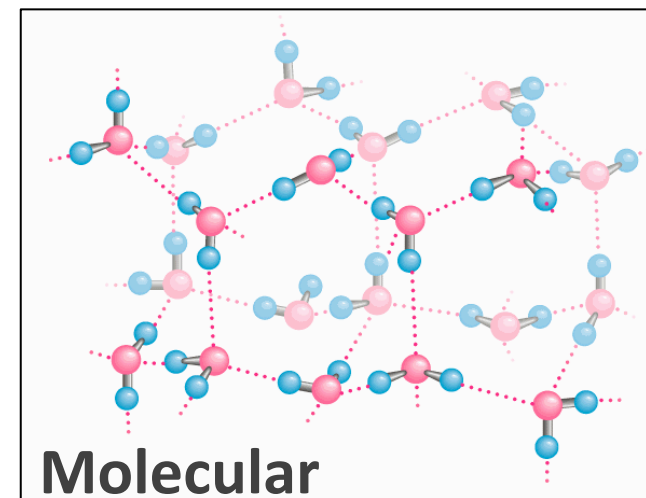
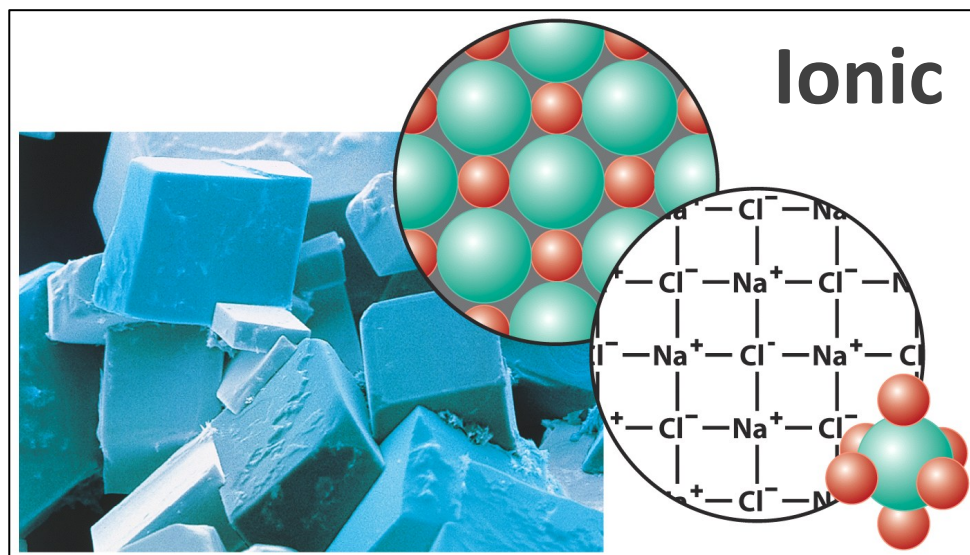
Diamonds are

- A. a bunch of carbon atoms held together by dispersion forces.
- B. a bunch of carbon atoms held together by dipole-dipole interactions.
- C. a bunch of carbon atoms covalently bound together.
- D. a bunch of C molecules held together by dispersion forces.

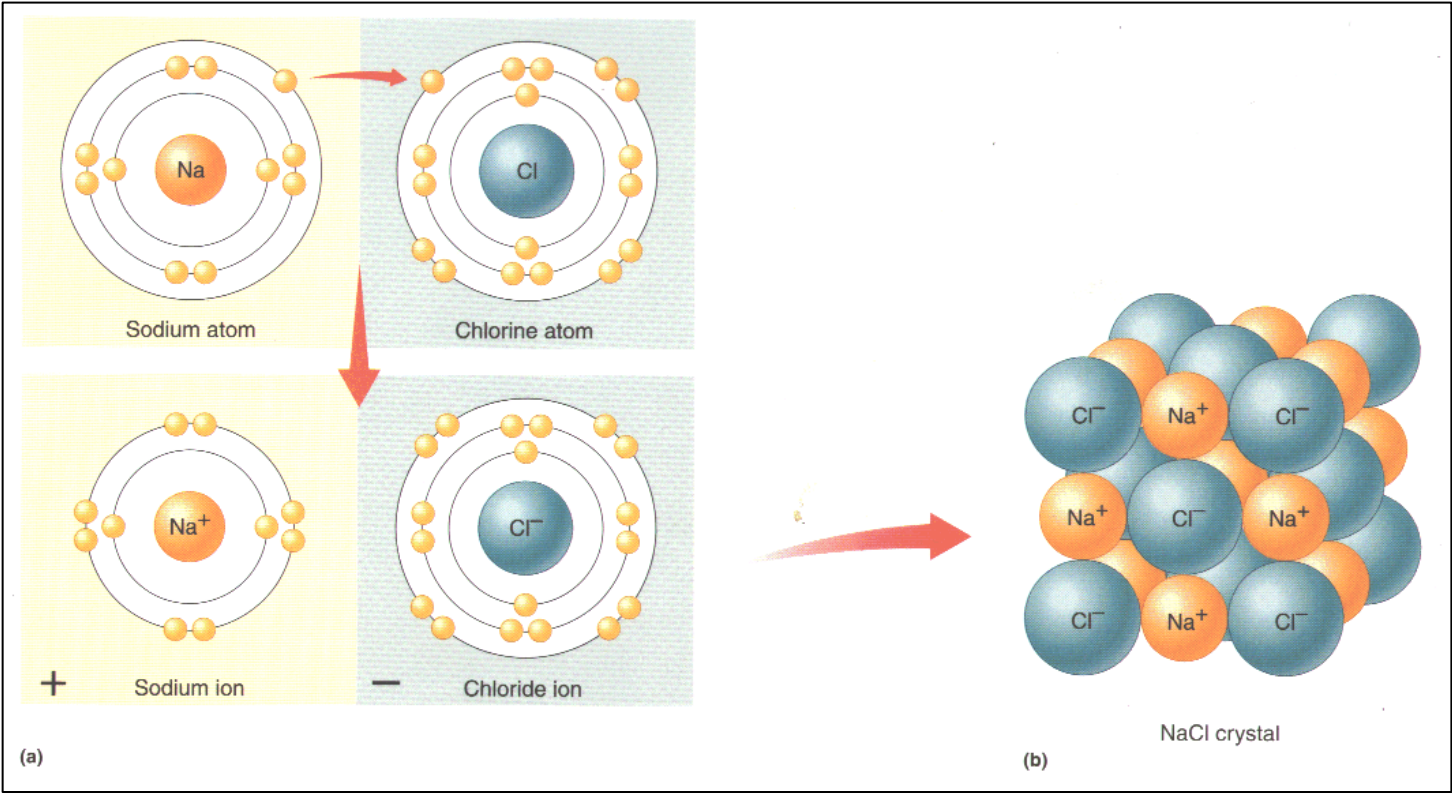




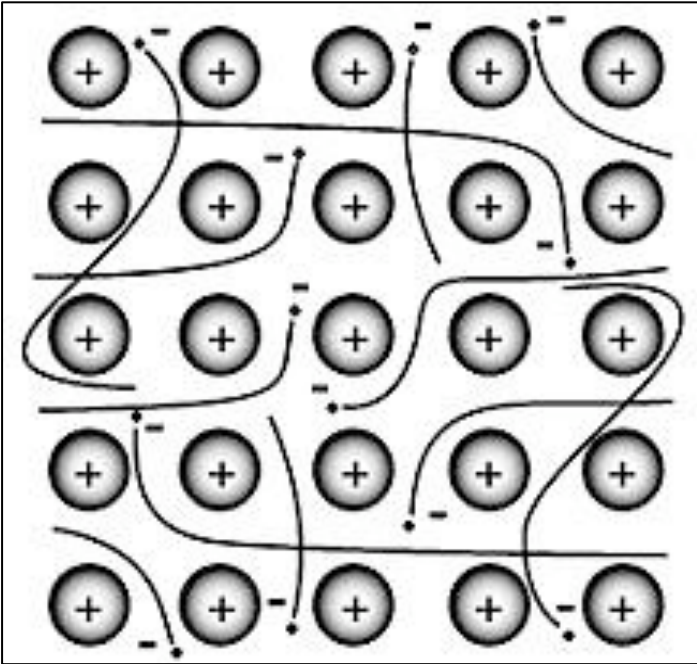
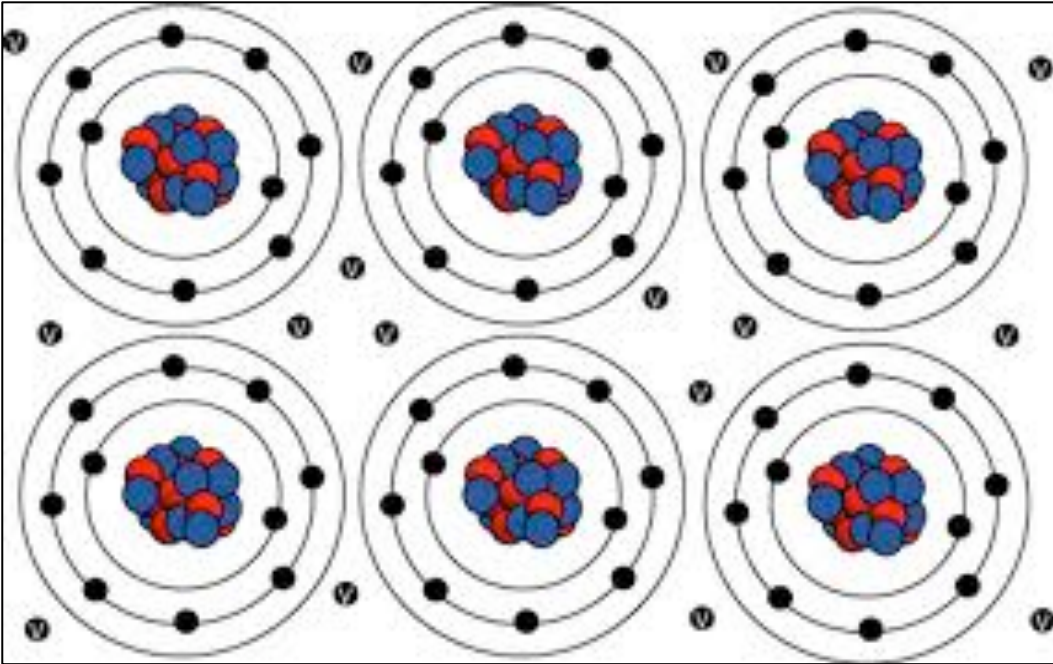
Types of Solids



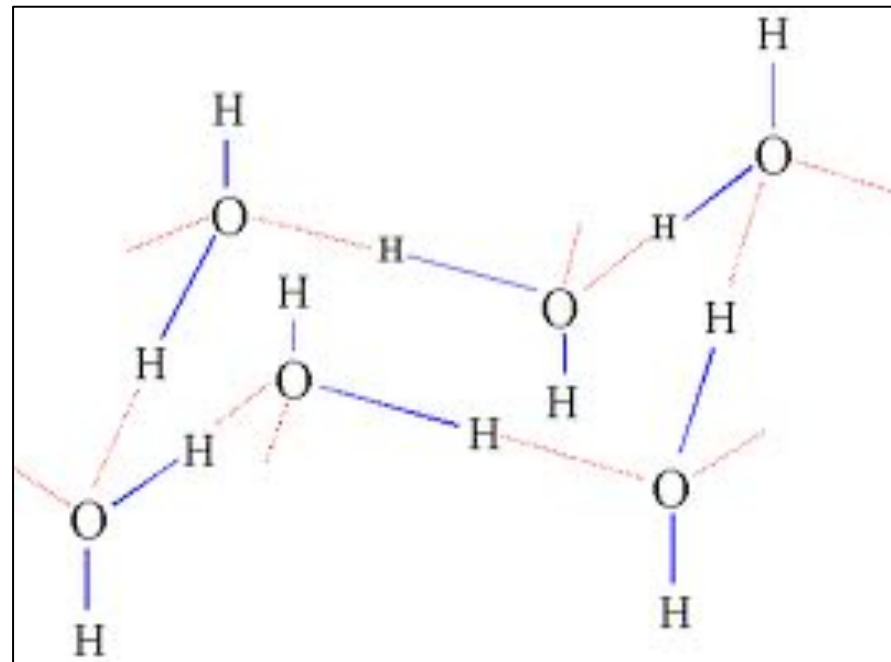
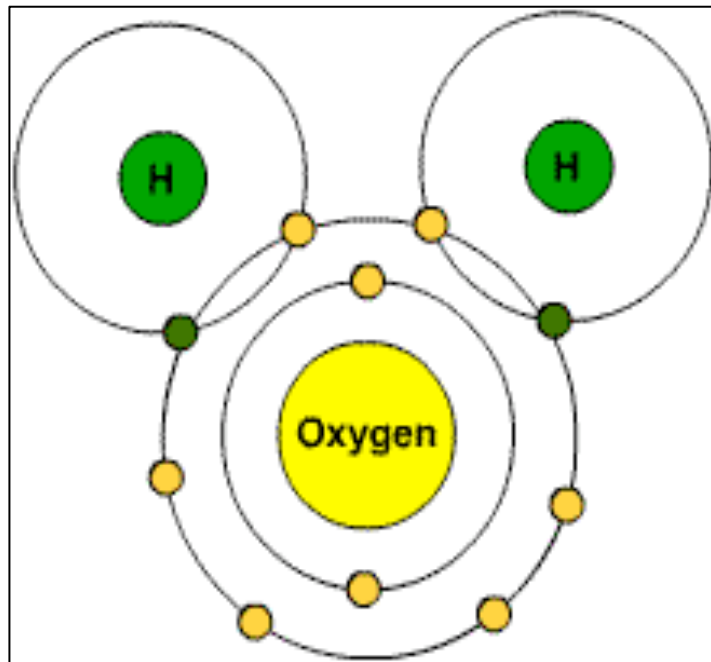
Ionic Solids



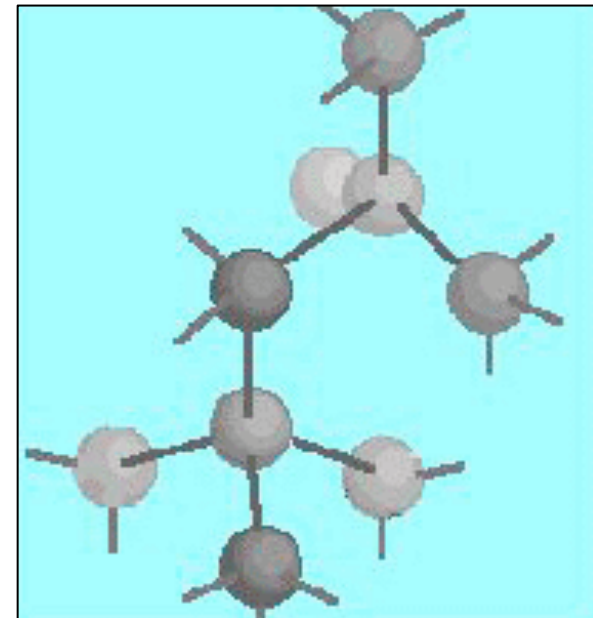
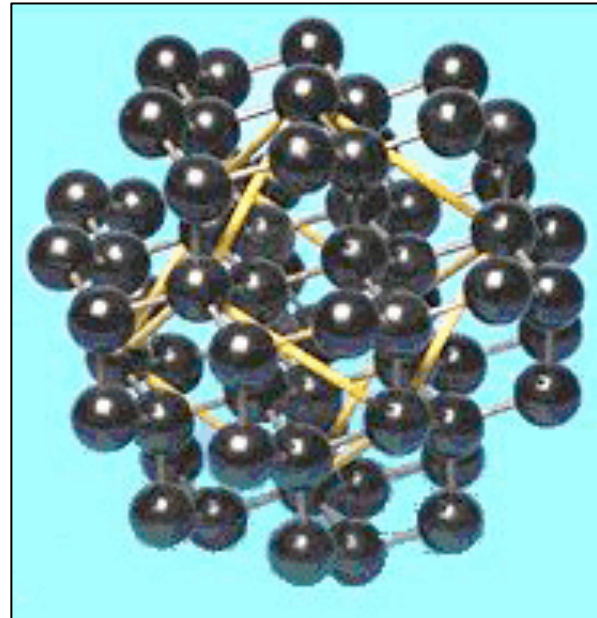
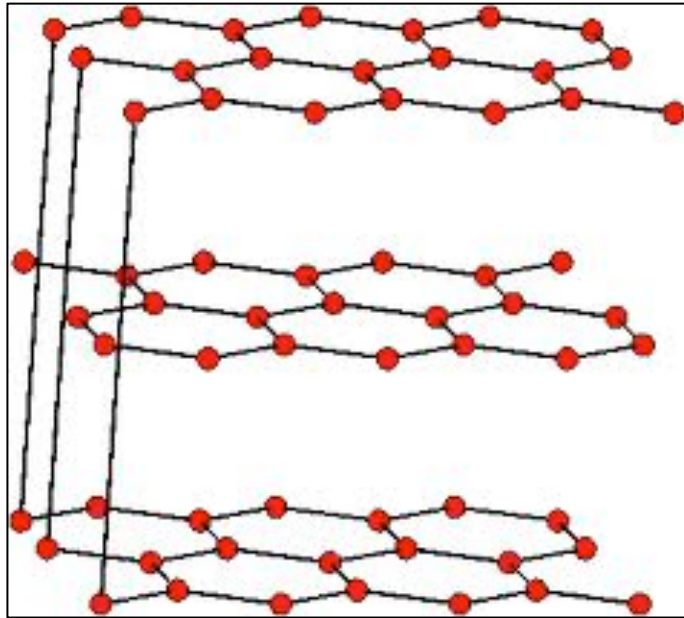
Metallic Solids



Molecular Solids



Network Solids



Types of Solids

Class	Examples	Characteristics
Ionic	NaCl, KNO ₃ , CuSO ₄ •H ₂ O	Hard, rigid, brittle; high melting/ boiling points; those soluble in water give conducting solutions
Network	B, C, black P, BN, SiO ₂	Hard, rigid, brittle; very high melting points; insoluble in water
Metallic	<i>s</i> - and <i>d</i> - elements	Malleable, ductile, lustrous; electrically and thermally conducting
Molecular	BeCl ₂ , S ₈ , P ₄ , I ₂ , ice, glucose	Relatively low melting/boiling points; brittle if pure

Physical Properties of Solids

Class	Electrons	Conductivity
Ionic	Localized	Not a good conductor (only conducts electricity in aqueous solutions)
Network	Localized	Not a good conductor
Metallic	Delocalized	Good conductor
Molecular	Localized	Not a good conductor

Predicting Melting Points

We can use melting points to distinguish between covalent and molecular solids.

Molecule	Melting Point [K]	Type of Solid
Diamond	3823	
SiO ₂	1900	
Gold	1337	
NaCl	1074	
Sugar	423	
Naphthalene	353	
Ice	273	
CO ₂	190	

Think about what you've learned

What can you tell me about potassium chlorate?

MP = 629 K

BP = 673 K

Think about what you've learned

What can you tell me about gold, Au?

MP = 1337 K

BP = 3129 K

Think about what you've learned

What can you tell me about ethanol, $\text{CH}_3\text{CH}_2\text{OH}$?

MP = 159 K

BP = 351 K

Think about what you've learned

What can you tell me about sand, SiO_2 ?

MP = 1900 K

BP = 2503 K

Review Liquid Properties: Vapor Pressure

Which of the following has the highest vapor pressure?

- A. CH_3OH
- B. $\text{CH}_3\text{CH}_2\text{OH}$
- C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

Question

In comparing two substances at the same temperature, we find that liquid X has a higher boiling point than liquid Y. Which do you expect to have the higher vapor pressure?

- A. X
- B. Y

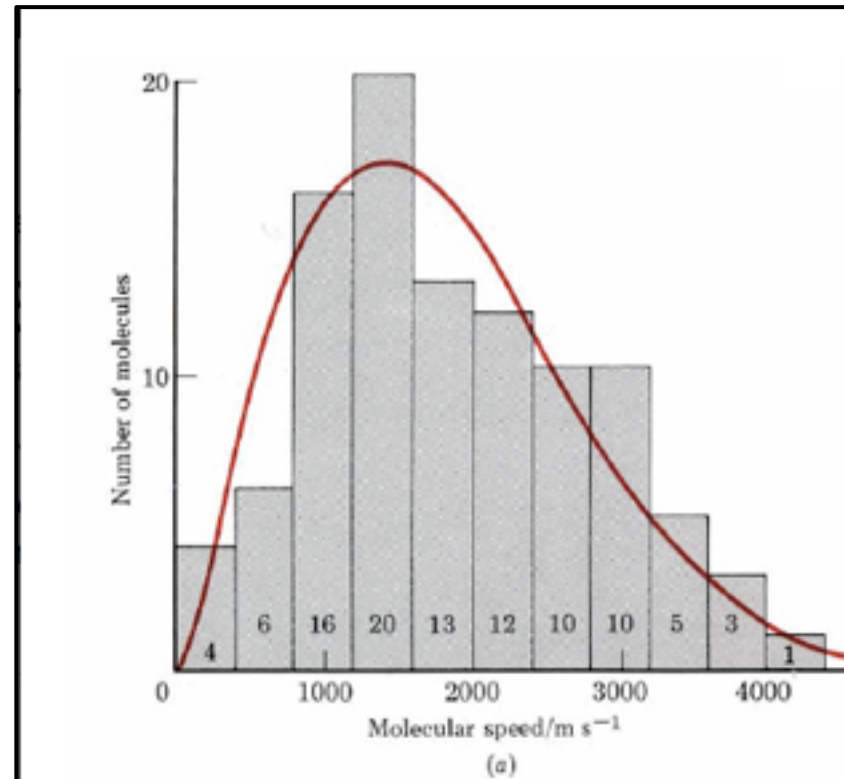
Evaporation

What is the boiling point of water?

Will water evaporate at temperatures lower than the BP? Why?

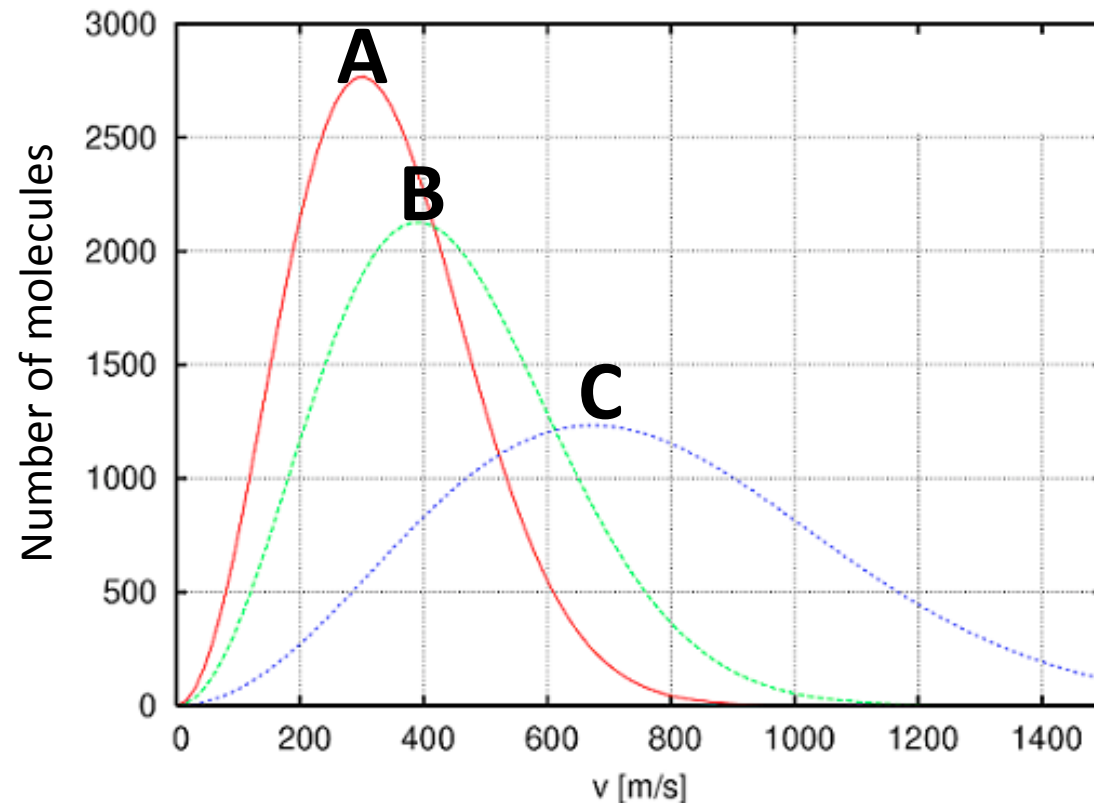
Evaporation

Boltzmann distribution explains evaporation



Question

Which distribution is at a higher T?



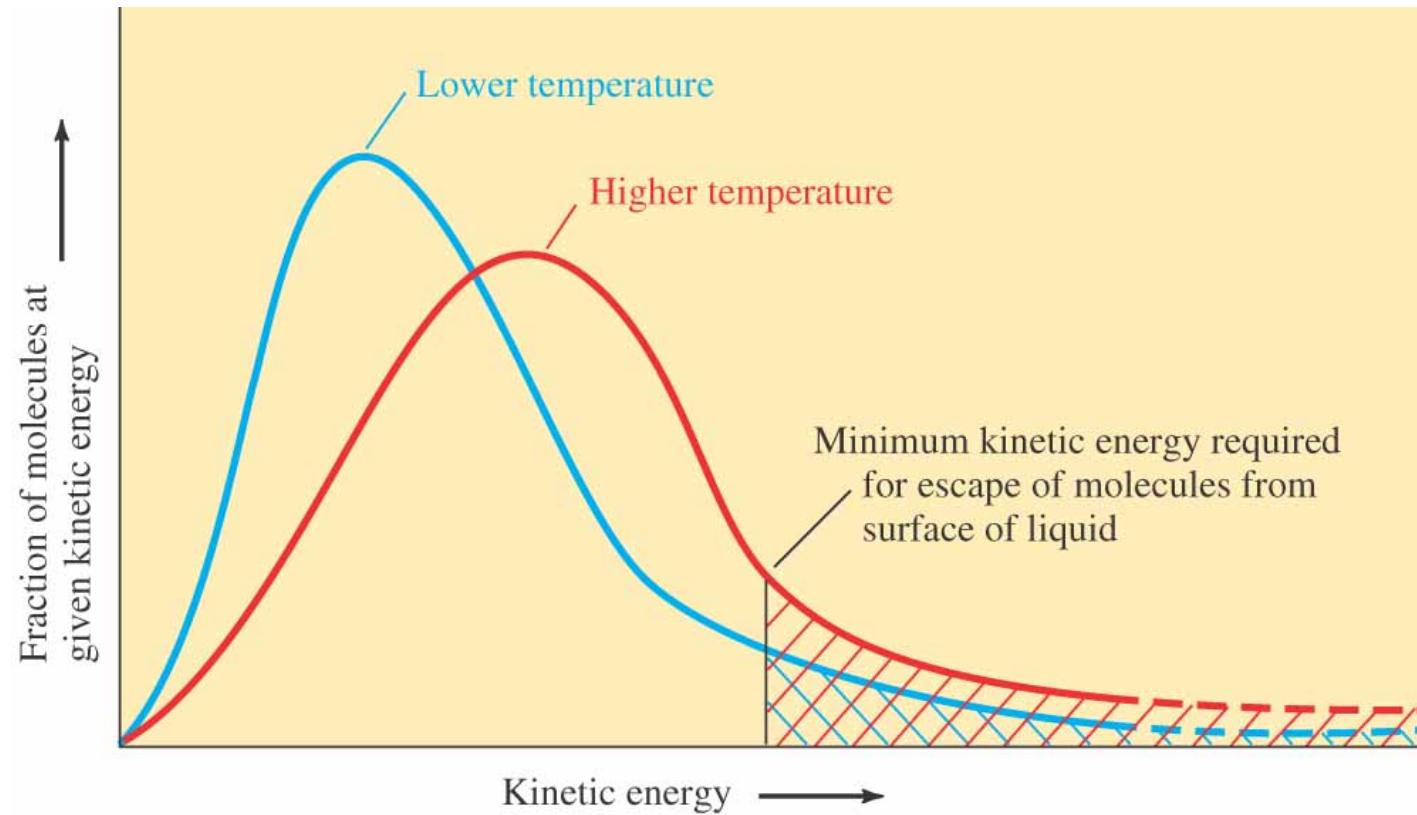
Question

Which would you predict would have the higher vapor pressure?

- A. Water at 25°C
- B. Water at 50°C

Why?

Temperature Dependence of Vapor Pressure



Question

Which do you think has the higher vapor pressure?

- A. $\text{CH}_3\text{CH}_2\text{OH}$
- B. CH_3OCH_3
- C. They would be the same.

Is vapor pressure always less than atmospheric pressure?

<https://www.youtube.com/watch?v=Ldgp3Ton7R4>

Review Liquid Properties: Viscosity

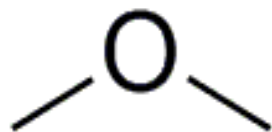
Viscosity races

Review Liquid Properties: Surface Tension

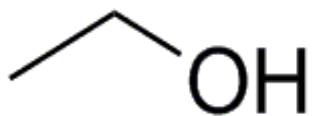
1. Pennies in Water
2. Pennies in Acetone



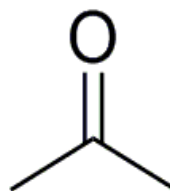
Consider the following molecules:



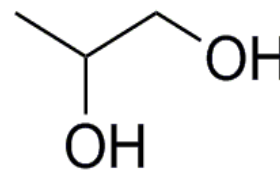
A



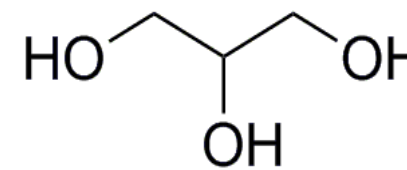
B



C



D



E

Which would you expect to have:

1. Lowest BP

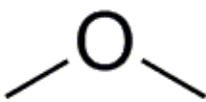
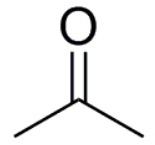
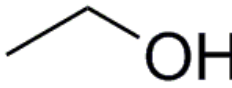
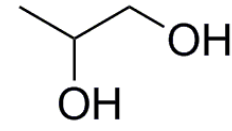
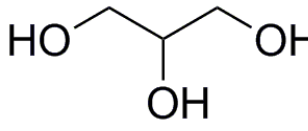
2. Highest BP

3. Highest VP

4. Highest viscosity

Hydrogen Bonding

The number of potential hydrogen bonds is very important.

					
Boiling Point	-24 °C	56 °C	79 °C	188 °C	554 °C
# of H Bonds	0	0	1	2	3