States of Mattter

What factors affect whether something is a solid, liquid or gas?

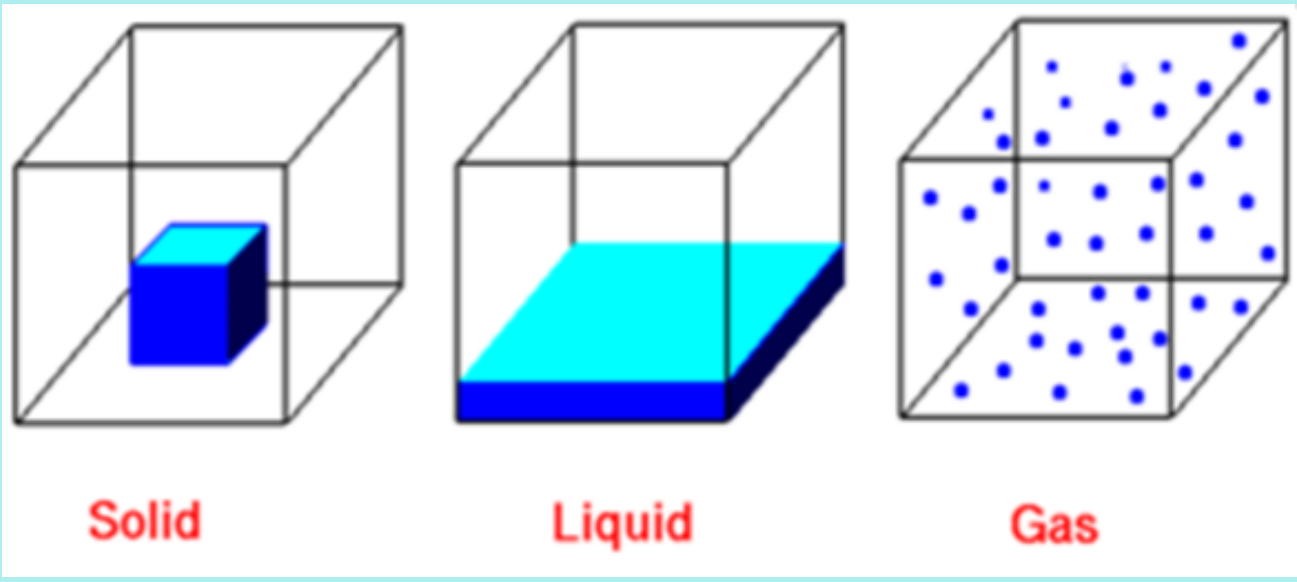
What actually happens (breaks) when you melt various types of solids?

What external factors affect whether something is a solid, liquid or a gas?

Feb 26-4:20 AM

States of Matter

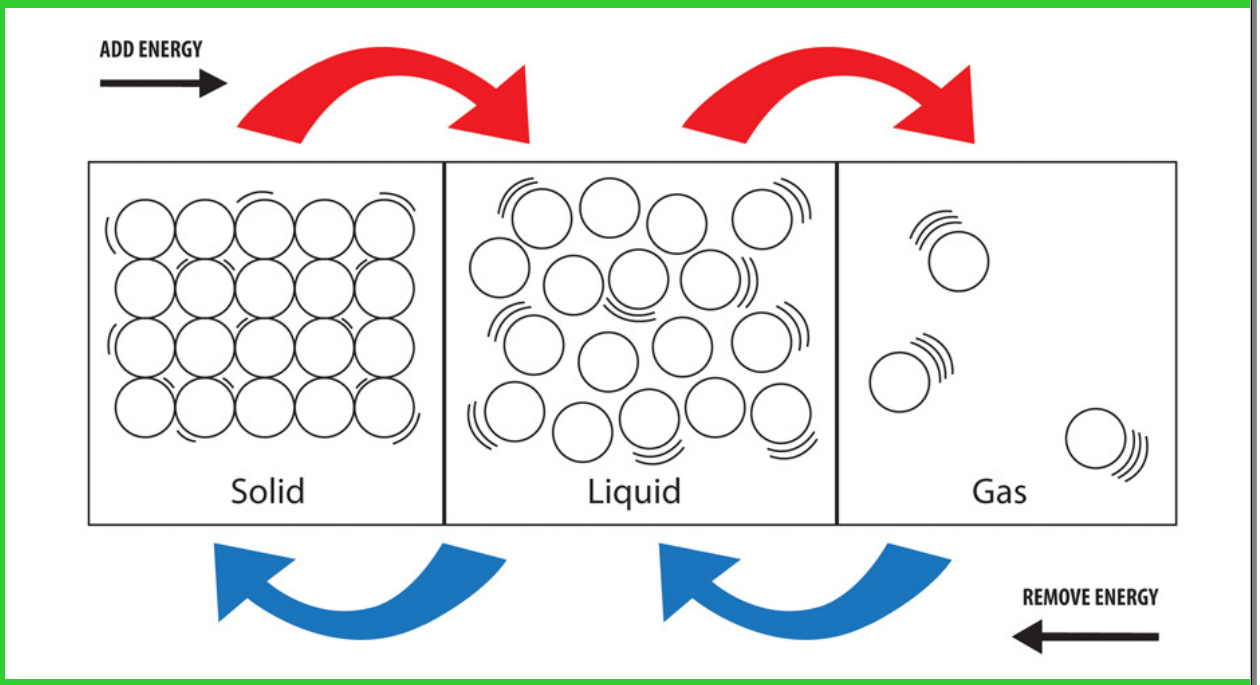
atoms tightly packed ⟷ atoms far apart



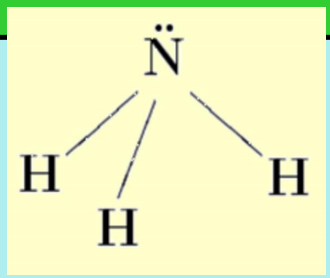
Solid	Liquid	Gas
Holds shape Fixed volume	Shape of Container Free Surface Fixed Volume	Shape of Container Volume of Container

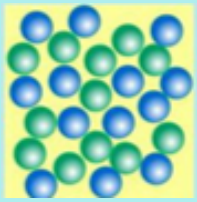
Feb 22-10:53 AM

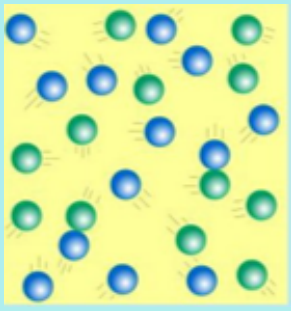
We can add or remove energy to change the state of matter:



ammonia







(exothermic)

release energy

liquid
lower energy

gas
higher energy

add energy
(endothermic)

Feb 20-1:14 PM

Internal factors that determines state of matter

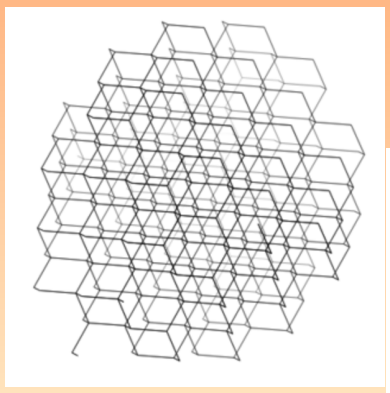
Strength of bond type:

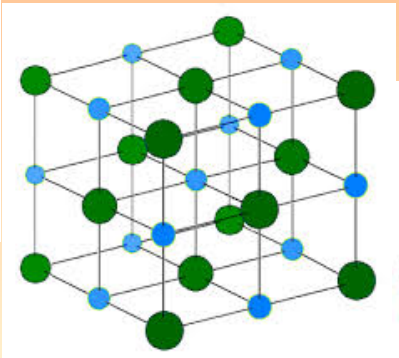
strongest

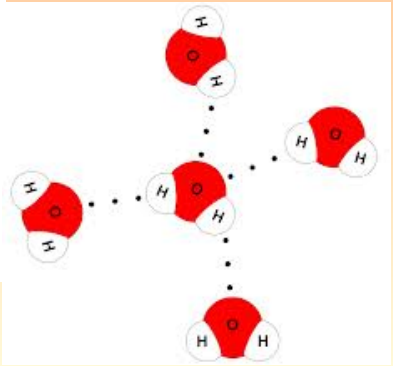
↓

weakest

1. covalent bonds (sharing e^-)
2. ionic bonds (tranferring e^-)
3. intermolecular forces (between covalent molecules)







+1 -1
K NO3

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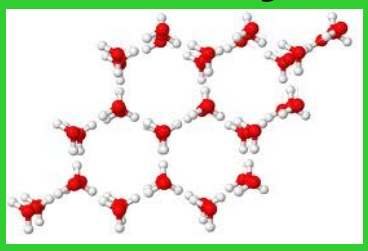
4 Types of Solids

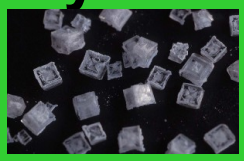
1. covalent molecular crystal (solid)

Ice
(H_2O)

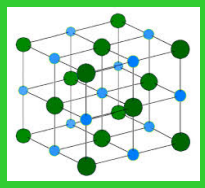


solids with
low MP
(s), (l), and (g) on Earth

2. ionic crystal



NaCl

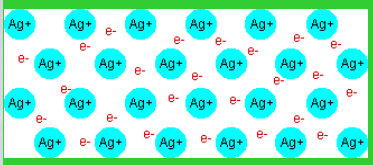


solid with
high MP

3. covalent network

solids with
very high MP

4. metallic solid



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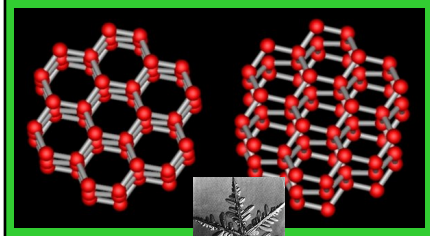
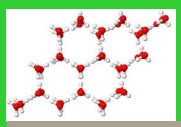
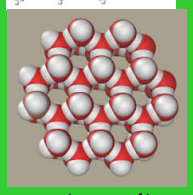
covalent molecular crystal (solid)



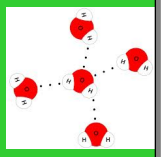


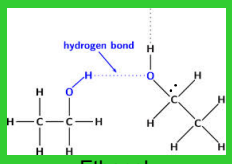


Ice

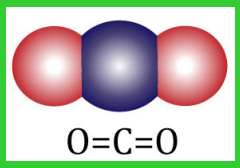
-must break intermolecular forces to melt
(weak and easy to do!)

-smaller molecules stay as units
(covalent bonds do not break)



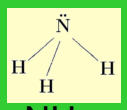


Ethanol



CO_2

states of matter depend on one of these:

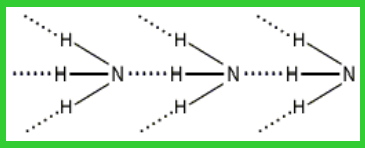


intramolecular bond
- bond **within** molecule (covalent) NH_3

intermolecular bond (IM)
- bonds **between** covalent molecules

examples:
hydrogen
dipole-dipole
London dispersion
Van der Waals

hydrogen bonds



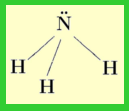
Coulomb's Law (positive and negative attration)

IM determined by:
1. Electronegativity
dipole moment -- creates polar bond

H - X

highly electronegative atoms:
N, O F and Cl

2. Symmetry



Solid Liquid or Gas?

no H bonding → strong H bonding

gas liquid solid

H_2

CH_4

H_2O

Feb 22-11:35 AM

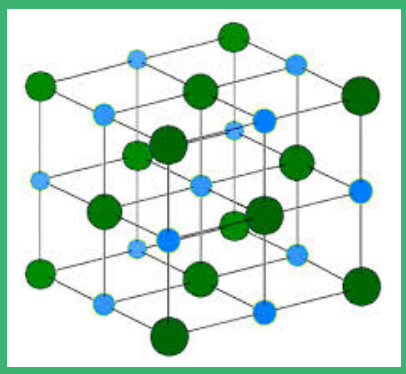
Ionic crystal (solid)

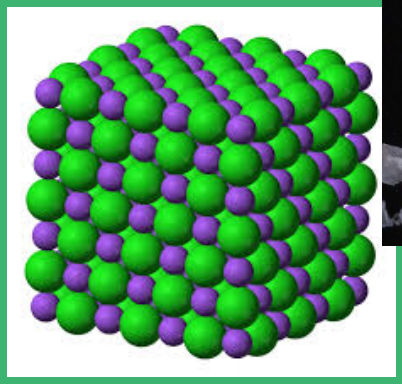
usually solid, (high MP)

-must break ionic bonds to melt

strong bond

NaCl





no intramolecular bonds to break

factors affecting MP of Ionic crystal

1. Difference of Charge
2. Atomic Radius

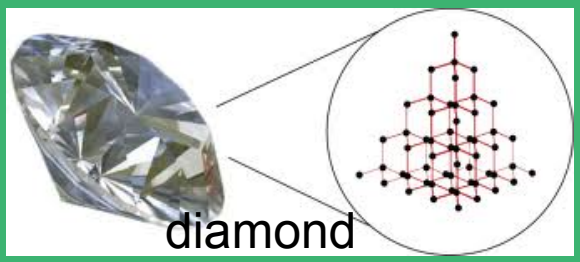
(coulomb's law)

Feb 22-11:35 AM

covalent network

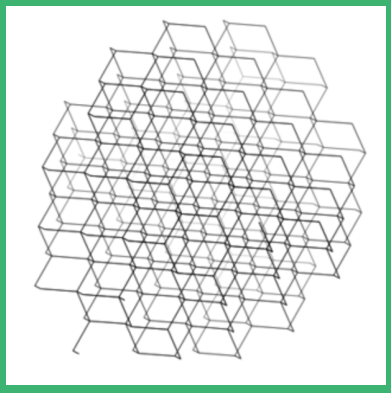
made from:

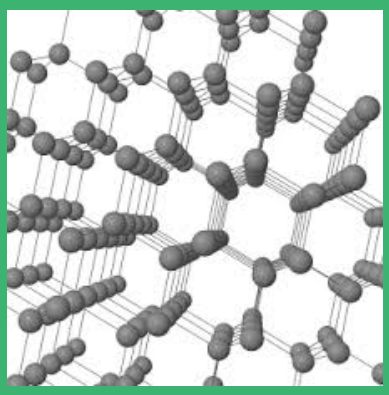
C
Si
G



-all covalent, no intermolecular forces

-must break covalent bonds to melt





need
lots of energy
and difficult
to break apart
(melt)

solids with very high MP

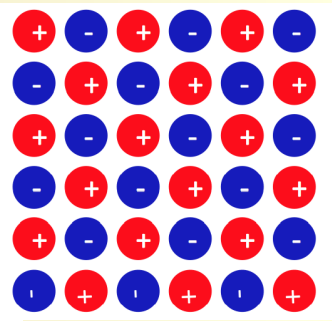
Feb 22-11:35 AM

What factors affect the melting point of ionic compounds?

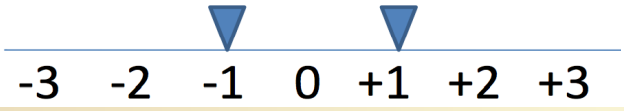
1. Difference of Charge
2. Atomic Radius

1. Difference of Charge

more +'s to more -'s have higher meltir

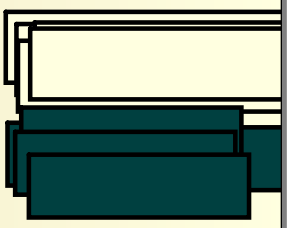


$NaF \quad (Na^{+1} \quad F^{-1})$



$Na_3P \quad (Na^{+} \quad P^{-3})$

Practice:
Assign charges
Rank order of increasing melting point.



	Assign charges	Rank
Ca_3P_2	Ca^{+2} P^{-3}	4
NaI	Na^{+1} I^{-1}	1 (lowest)
$MgSO_4$	Mg^{+2} SO_4^{-2}	3
$MgCl_2$	Mg^{+2} Cl^{-1}	2
AlN	Al^{+3} N^{-3}	5 (highest)

Coulombic Attraction

Feb 24-12:49 PM

2. Atomic Radius

NaF

NaCl

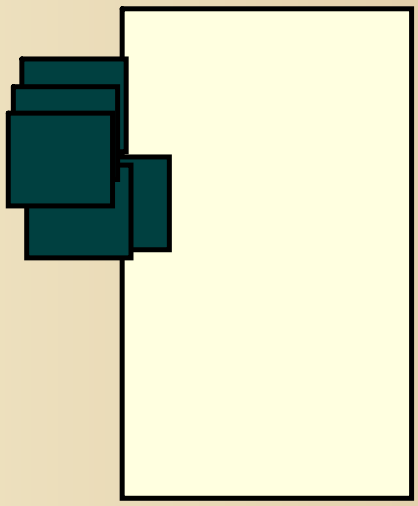
NaBr

NaI

larger atomic radius = weaker bonds

Practice:

	Charges	
$CaCl_2$	Ca^{+2} Cl^{-1}	3
NaCl	Na^{+1} Cl^{-1}	1
NaF	Na^{+1} F^{-1}	2
$AlCl_3$	Al^{+3} Cl^{-1}	4
AlP	Al^{+3} P^{-3}	5



Look at charge first

Then look at radius with same charge difference (+1, -1)

Weaker (larger) melts at lower temperature

Feb 24-12:49 PM

External Factors that affect state of matter:

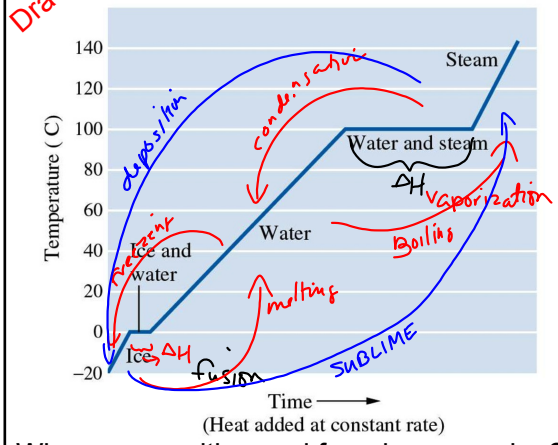
1. Temperature
2. Pressure

Phase changes

Let's look at temperature:

Figure 11.9: Heating curve for water.

Draw this!



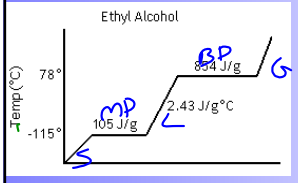
Where are melting and freezing occurring?
where the lines are horizontal
(at 0°C and 100°C)

Why is the line horizontal at these points?

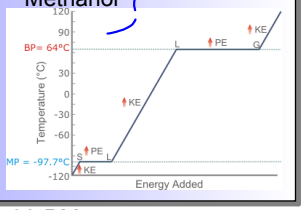
It takes more energy to break the bonds that hold water together
temperature does not increase during melting and freezing

Other substances:

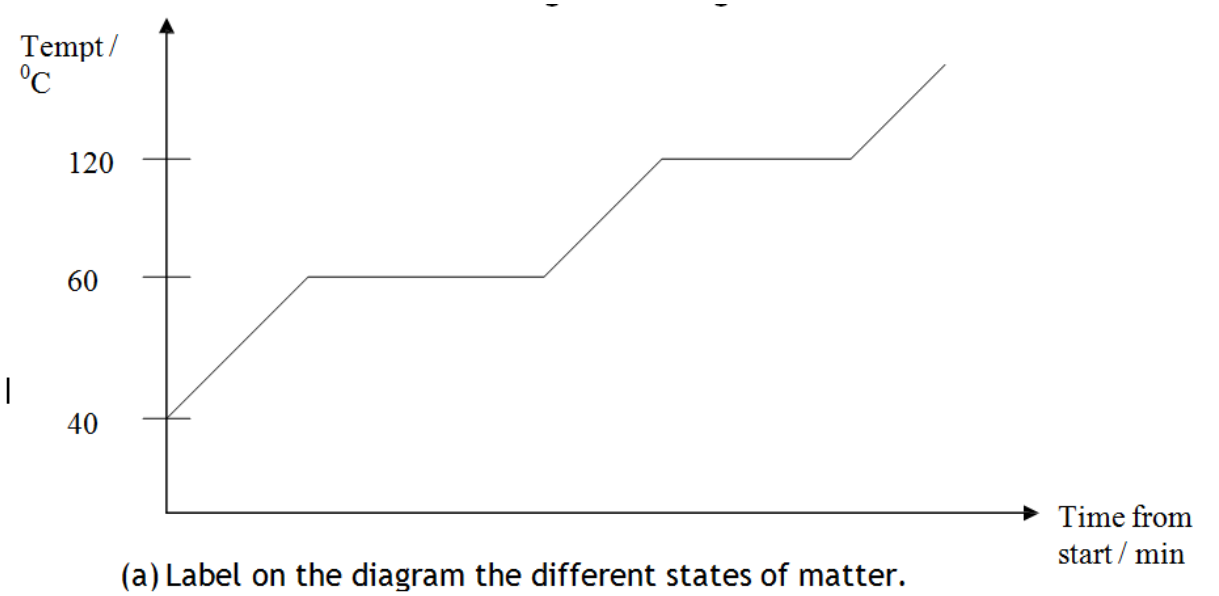
Ethanol



Methanol



Mar 26-3:33 PM



(a) Label on the diagram the different states of matter.
(b) Read from the graph the melting point and boiling point of the substance.

Where are melting and boiling occurring?

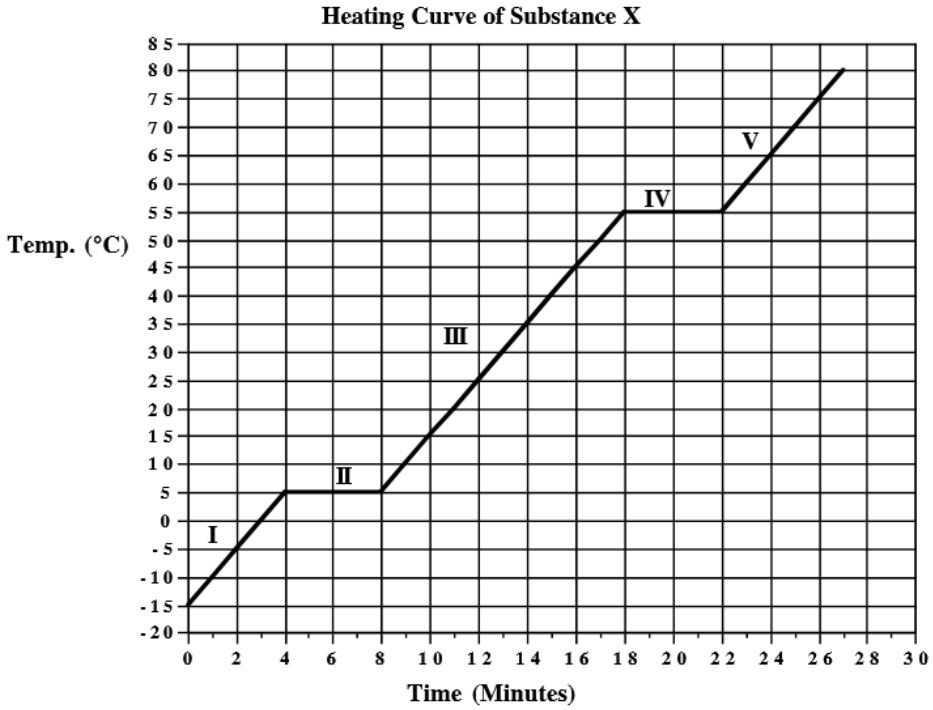
where the lines are horizontal

(at 0°C and 100°C)

Why is the line horizontal at these points?

Feb 27-4:31 PM

CHEMISTRY **HEATING CURVE WORKSHEET**



The heating curve shown above is a plot of temperature vs time. It represents the heating of substance X at a constant rate of heat transfer. Answer the following questions using this heating curve:

_____1. In what part of the curve would substance X have a definite shape and definite volume?

_____2. In what part of the curve would substance X have a definite volume but no definite shape?

_____3. In what part of the curve would substance X have no definite shape or volume?

_____4. What part of the curve represents a mixed solid/liquid phase of substance X?

_____5. What part of the curve represents a mixed liquid/vapor phase of substance X?

_____6. What is the melting temperature of substance X?

_____7. What is the boiling temperature of substance X?

Feb 28-9:29 AM

Comparing Temperature Scales

5) H Bonding | dipole-dipole

assymetry
polarity/difference in electroneg.

Feb 27-4:29 PM