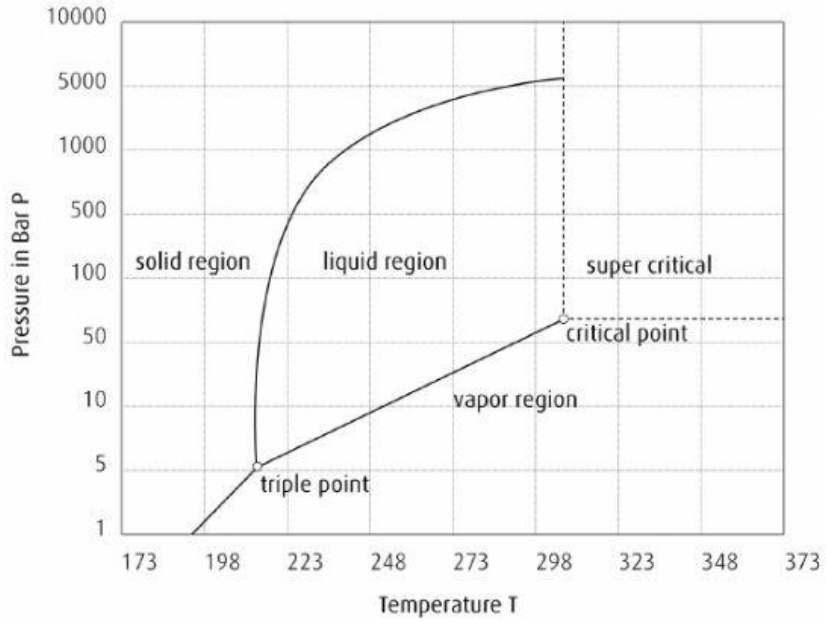
UNIT 6: Phase Diagram Review



The diagram above shows a Phase diagram for a substance

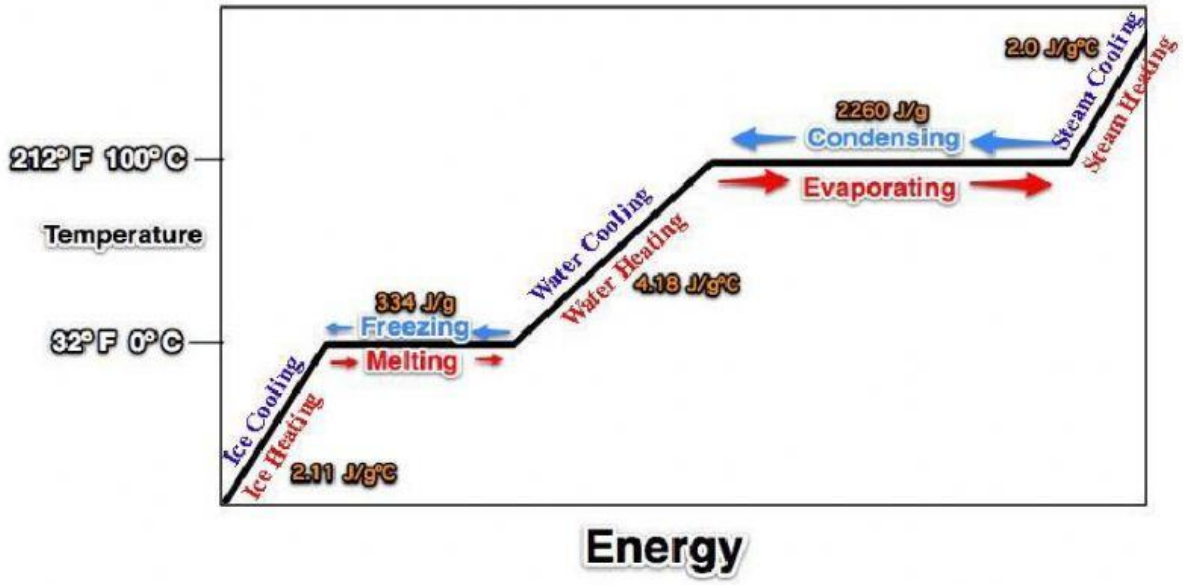
- The solid phase has _____ (high, low) temperature and _____ (high low) pressure.
- The gas phase has _____ (high, low) temperature and _____ (high low) pressure.
- Melting occurs when _____
- Freezing occurs when _____
- boiling occurs when _____
- condensing occurs when _____
- sublimation occurs when _____
- deposition occurs when _____

Name the phase change

1) A substance at 248 Kelvin undergoes a change in pressure from 5000 bars to 100 bars.
2) A substance at 15 bars undergoes a temperature change from 273 Kelvin to 223 Kelvin.
3) A substance at 3 bars undergoes a temperature change from 185 Kelvin to 248 Kelvin
4) A substance at a temperature of 198 Kelvin undergoes a pressure change from 1 bar to 5 bars

Heating Curve Review

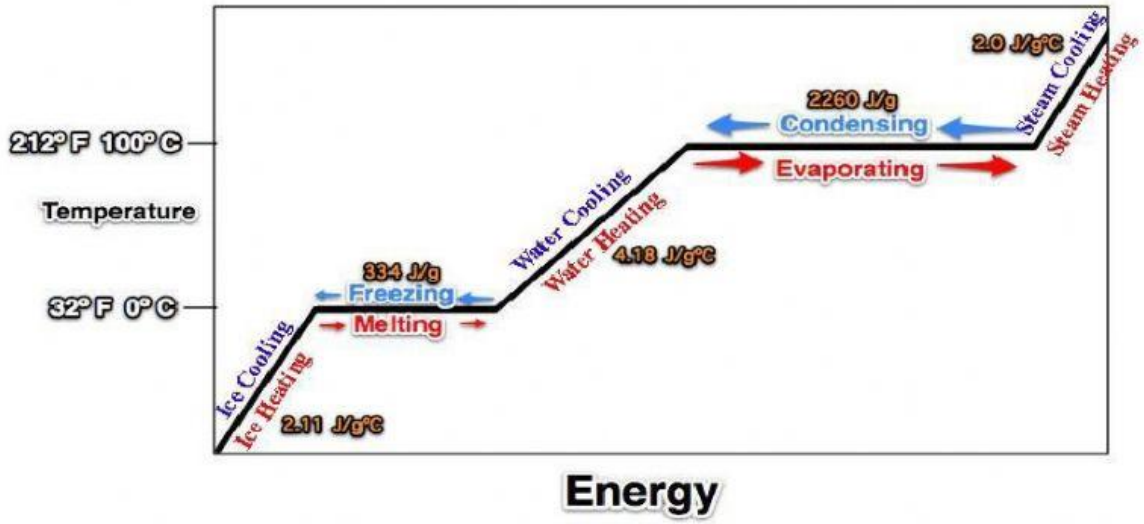
The diagram below represents both a heating curve and a cooling curve for H_2O. There are 5 distinct regions on this graph.



Region one (temp is below melting point)

When we add or remove heat to ice that is below the _____ (melting point, boiling point) of water, the temperature of the ice _____ (increases, decreases, remains the same). In this region, we have _____ (solid only, solid and liquid, liquid only).

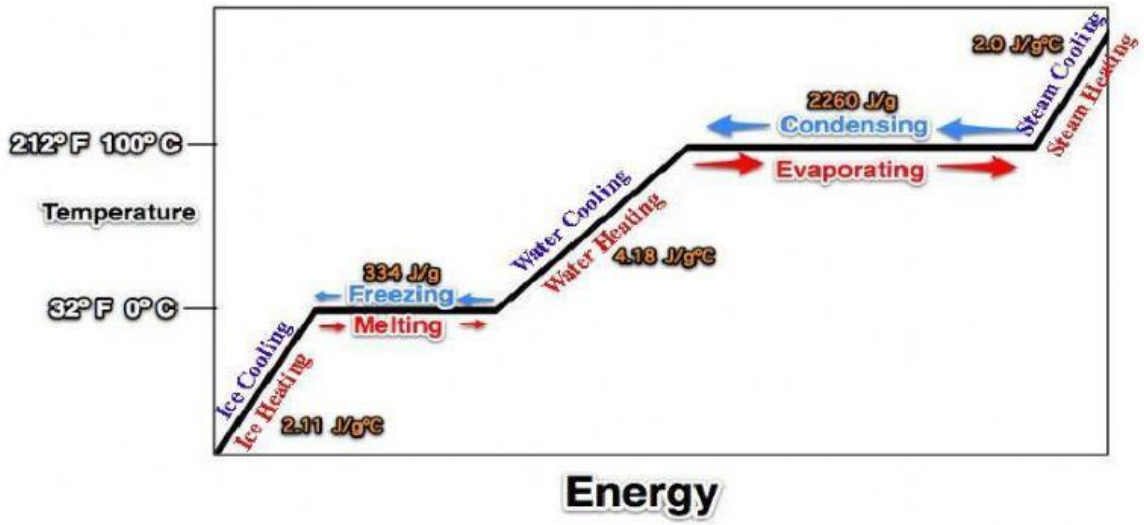
- The specific heat of ice is _____Joules per (g C)
    - This means that adding 2.05 Joules of energy to _____ gram of ice will _____ (increase, decrease) the temperature of ice by ___ degree Celsius.
    - This means that removing 2.05 Joules of energy from _____ gram of ice will _____ (increase, decrease) the temperature of ice by ___ degree Celsius.
- Adding heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) meaning that the particles will move _____ (faster, slower, remain at same speed)
- If heat is being added in this region (below the melting point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{fus}$, $q=mH_{vap}$) and the specific heat of ice c=_____ J/gC.



Region Two (temp is at the melting point)

When we add or remove heat to H_2O that is at its melting point, the temperature of H_2O _____ (increases, decreases, remains the same) and **melting or freezing occurs.** In this region, we have _____ (solid only, solid and liquid, liquid only).

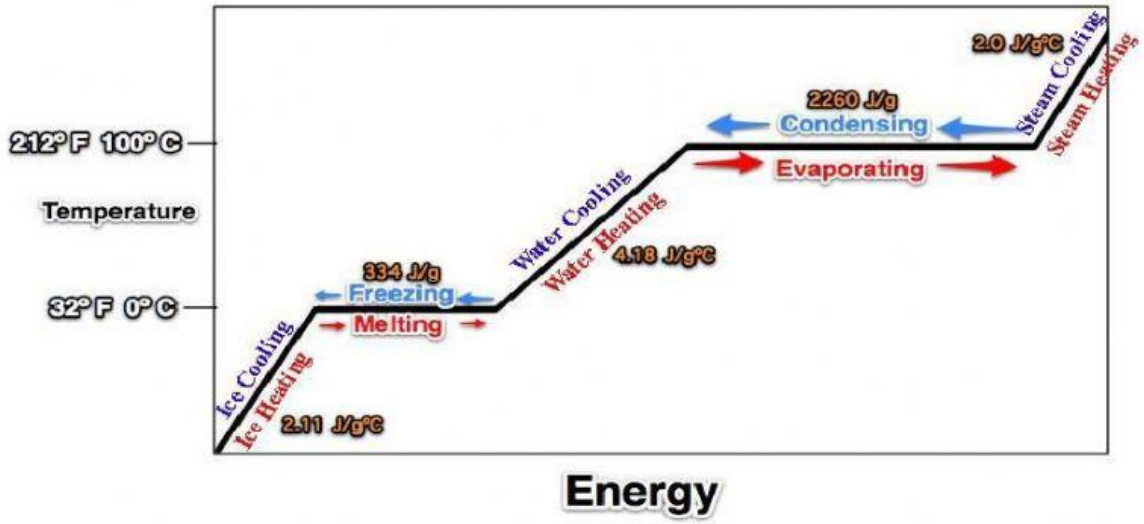
- The heat of fusion for H_2O is _____Joules per gram
  - This means that adding 334 Joules of energy will _____ (increase the temperature of, melt, freeze) one gram of H_2O.
  - This means that removing 334 Joules of energy will _____ (increase the temperature of, melt, freeze) one gram of H_2O.
- Adding heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) of the H_2O molecules meaning that the H_2O molecules will get _____ (closer together, further apart). This results in _____ (bond breaking, bond forming) which is an _____ (endothermic, exothermic) process.
- Removing heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) of the H_2O molecules meaning that the H_2O molecules will get _____ (closer together, further apart). This results in _____ (bond breaking, bond forming) which is an _____ (endothermic, exothermic) process.
- If heat is being added to H_2O in this region (at the melting point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{fus}$, $q=mH_{vap}$) with the Heat of fusion of water being _____(4.18, 334, 2260) Joules per Gram
- If heat is being removed from H_2O in this region (at the melting point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{freeze}$, $q=mH_{cond}$) with the molar enthalpy of freezing being _____(4.18, 334, -334, 2260, -2260) Joules per Gram.



Region three (temp is above the melting point)

When we add or remove heat to ice that is above the _____ (melting point, boiling point) of water, the temperature of the ice _____ (increases, decreases, remains the same). In this region, we have _____ (solid only, solid and liquid, liquid only).

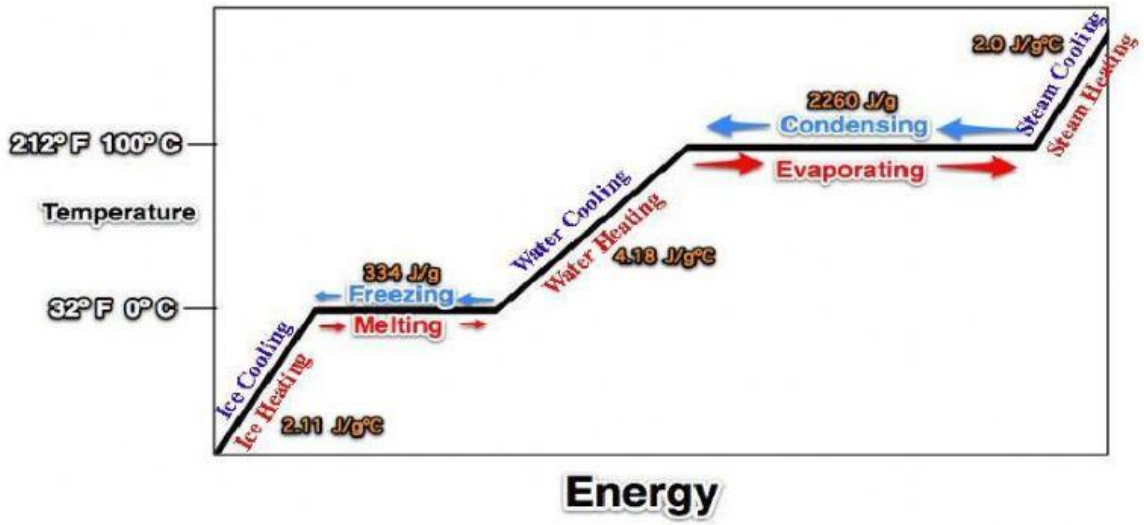
- The specific heat of liquid water is _____Joules per (g C)
    - This means that adding 4.18 Joules of energy to _____ gram of liquid water will _____ (increase, decrease) the temperature of water by ___ degree Celsius.
    - This means that removing 4.18 Joules of energy from _____ gram of liquid water will _____ (increase, decrease) the temperature of liquid water by ___ degree Celsius.
- Adding heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) meaning that the particles will move _____ (faster, slower, remain at same speed)
- If heat is being added in this region (above the melting point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{fus}$, $q=mH_{vap}$) and the specific heat of liquid water is c=_____ J/gC.



Region Four (temp is at the boiling point)

When we add or remove heat to H_2O that is at its boiling point, the temperature of H_2O _____ (increases, decreases, remains the same) and either **boiling or condensation occurs.** In this region, we have _____ (liquid only, liquid and gas, gas only).

- The heat of Vaporization for H_2O is _____Joules per gram
    - This means that adding 2260 Joules of energy will _____ (increase the temperature of, melt, freeze) one gram of H_2O.
    - This means that removing 2260 Joules of energy will _____ (increase the temperature of, melt, freeze) one gram of H_2O.
- Adding heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) of the H_2O molecules meaning that the H_2O molecules will get _____ (closer together, further apart). This results in _____ (bond breaking, bond forming) which is an _____ (endothermic, exothermic) process.
- Removing heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) of the H_2O molecules meaning that the H_2O molecules will get _____ (closer together, further apart). This results in _____ (bond breaking, bond forming) which is an _____ (endothermic, exothermic) process.
- If heat is being added to H_2O in this region (at the boiling point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{fus}$, $q=mH_{vap}$) with the Heat of fusion of water being _____(4.18, 334, 2260) Joules per Gram
- If heat is being removed from H_2O in this region (at the boiling point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{freeze}$, $q=mH_{cond}$) with the molar enthalpy of condensation being _____(4.18, 334, -334, 2260, -2260) Joules per Gram.



Region five (temp is above the boiling point)

When we add or remove heat to ice that is above the _____ (melting point, boiling point) of water, the temperature of the ice _____ (increases, decreases, remains the same). In this region, we have _____ (Liquid only, liquid and gas, gas only).

- The specific heat of water vapor is _____Joules per (g C)
    - This means that adding 2.02 Joules of energy to _____ gram of steam will _____ (increase, decrease) the temperature of steam by ___ degree Celsius.
    - This means that removing 2.02 Joules of energy from _____ gram of steam will _____ (increase, decrease) the temperature of steam by ___ degree Celsius.
- Adding heat in this region will _____ (increase, decrease) the_____ (kinetic energy, potential energy) meaning that the particles will move _____ (faster, slower, remain at same speed)
- If heat is being added in this region (above the boiling point), we would use the equation _____ ($q=mc(\Delta T)$,$q=mH_{fus}$, $q=mH_{vap}$) and the specific heat of steam is c=_____ J/gC.

Reference this section of your reference packet

Chemistry Reference Tables

Name	Value
Avogadro's number	6.022×10^{23} particles/mole
Gas constant (R)	$0.0821 \frac{\text{L atm}}{\text{mole K}}$ $62.4 \frac{\text{L mmHg}}{\text{mole K}}$ $8.314 \frac{\text{L kPa}}{\text{mole K}}$
Standard pressure	1.00 atm = 101.3 kPa = 760. mmHg = 760. torr
Standard temperature	0°C or 273K
Volume of 1 mole of any gas at STP	22.4 L

Thermodynamic Constants	Symbol	Value
Heat of fusion of water	H_f (water)	334 J/g
Heat of vaporization of water	H_v (water)	2,260 J/g
Specific heat of water	C_p (water)	$2.05 \frac{\text{J}}{\text{g°C}}$ for ice, $2.02 \frac{\text{J}}{\text{g°C}}$ for steam, $4.18 \frac{\text{J}}{\text{g°C}}$ for liquid

Metal	Specific Heat $\frac{\text{J}}{\text{g°C}}$	Density (g/cm^3)	Melting Point (°C)
Aluminum	0.897	2.702	660
Copper	0.385	8.92	1083
Gold	0.129	19.31	1064
Iron	0.449	7.86	1535
Lead	0.129	11.3437	328
Magnesium	1.023	1.74	649
Mercury	0.140	13.5939	−39
Nickel	0.444	8.90	1455
Titanium	0.523	4.5	1660
Zinc	0.388	7.14	420

When you see @ STP, what values do you use?
T= _____
P=_____

What is standard pressure in kpa?

What is the gas constant R that contains mmHg

What is the Heat of fusion of water?

What is the specific heat of liquid water?

What is the specific heat of Mercury?

When you are melting H_2O, what heat constant do you use?

When you are condensing H_2O, what is the molar enthalpy of condensation?

When you are trying to decrease the temperature of Lead, you need to use the specific heat c=_____ J/gC.

If you are using the equation PV=nRT and you are given the temperature is 50 degrees Celsius, what temperature value should you put into this equation? T= _____ Kelvin

Reference the following information to work through the problems

Name	Value
Avogadro's number	6.022×10^{23} particles/mole
Gas constant (R)	$0.0821 \frac{L\ atm}{mole\ K}$ $62.4 \frac{L\ mmHg}{mole\ K}$ $8.314 \frac{L\ kPa}{mole\ K}$
Standard pressure	1.00 atm = 101.3 kPa = 760. mmHg = 760. torr
Standard temperature	0°C or 273K
Volume of 1 mole of any gas at STP	22.4 L

Thermodynamic Constants	Symbol	Value
Heat of fusion of water	H_f (water)	334 J/g
Heat of vaporization of water	H_v (water)	2,260 J/g
Specific heat of water	C_p (water)	$2.05 \frac{J}{g°C}$ for ice, $2.02 \frac{J}{g°C}$ for steam, $4.18 \frac{J}{g°C}$ for liquid

Metal	Specific Heat $\frac{J}{g°C}$	Density (g/cm^3)	Melting Point (°C)
Aluminum	0.897	2.702	660
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$K = °C + 273$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$P_t = P_1 + P_2 + P_3 + \dots$

$M_1V_1 = M_2V_2$

$PV = nRT$

$M = \frac{\text{moles of solute}}{\text{liter of solution}}$

$q = mC_p\Delta T$

$q = mH_v$

$q = mH_f$

m = mass

V = volume

K = Kelvin

P = pressure

R = gas constant

T = temperature

M = molarity

n = number of moles

q = quantity of heat energy

Question 1: A container with Nitrogen gas, hydrogen gas, and water vapor has a total pressure of 25 atm. If the partial pressure of Nitrogen gas and Hydrogen gas is 10 atm and 7 atm respectively, what is the partial pressure of water vapor?

Question 2: A gas is said to have a pressure of 800 mmHg. What would this pressure be in kpa?

Question 3: 10 moles of hydrogen gas occupies a 15 liter container at 350 K. What would the pressure be inside the container in mmHg?

Question 4: 15 liters of nitrogen gas is contained in a large balloon at STP. If the temperature of the gas were to increase to 500 Kelvin and the pressure was to decrease to 75 kpa, what would be the new volume of the gas?

Question 5: How much heat would be needed to melt 50 grams of ice?

Question 6: The molar enthalpy of condensation for Methanol (CH_3OH) is given as ΔH= -35300 J/g. How many grams of methanol would condense with the release of 25000 J of heat?

Question 7: After adding 5000 Joules of heat to 50 grams of liquid water held at 25 degrees Celsius, how much would the temperature of water change?

Question 8: After removing 420 Joules of heat from a 100 gram sample of metal, the temperature of the substance drops from 100 Degrees Celsius to 70 degrees Celsius. What is the element symbol for the substance?