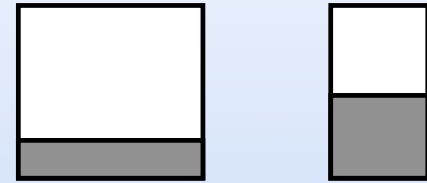


What do you remember from last time?

You have two containers.
one has a total volume of 2 L and
one has a total volume of 1 L
Into each you place 500 mL of liquid ether



Which container has a higher pressure at equilibrium?

- A. the 2 L container
- B. the 1 L container
- C. they are exactly the same ←
- D. it depends on the temperature

What do you remember from last time?

You have two containers
one has a total volume of 2 L and
one has a total volume of 1 L
Into each you place 500 mL of liquid ether



Which container has a greater number of
ether molecules in the gas phase at equilibrium?

- A. the 2 L container ←
- B. the 1 L container
- C. they are exactly the same
- D. it depends on the temperature

Vapor Pressure is determined primarily from $\Delta_{\text{vap}}H$

$\Delta_{\text{vap}}H$ depends on the intermolecular forces

Vapor Pressure is independent of volume

Neither the volume of the gas or liquid matter

Vapor Pressure is a strong function of temperature

The Vapor Pressure is the
PARTIAL PRESSURE OF THAT SUBSTANCE!

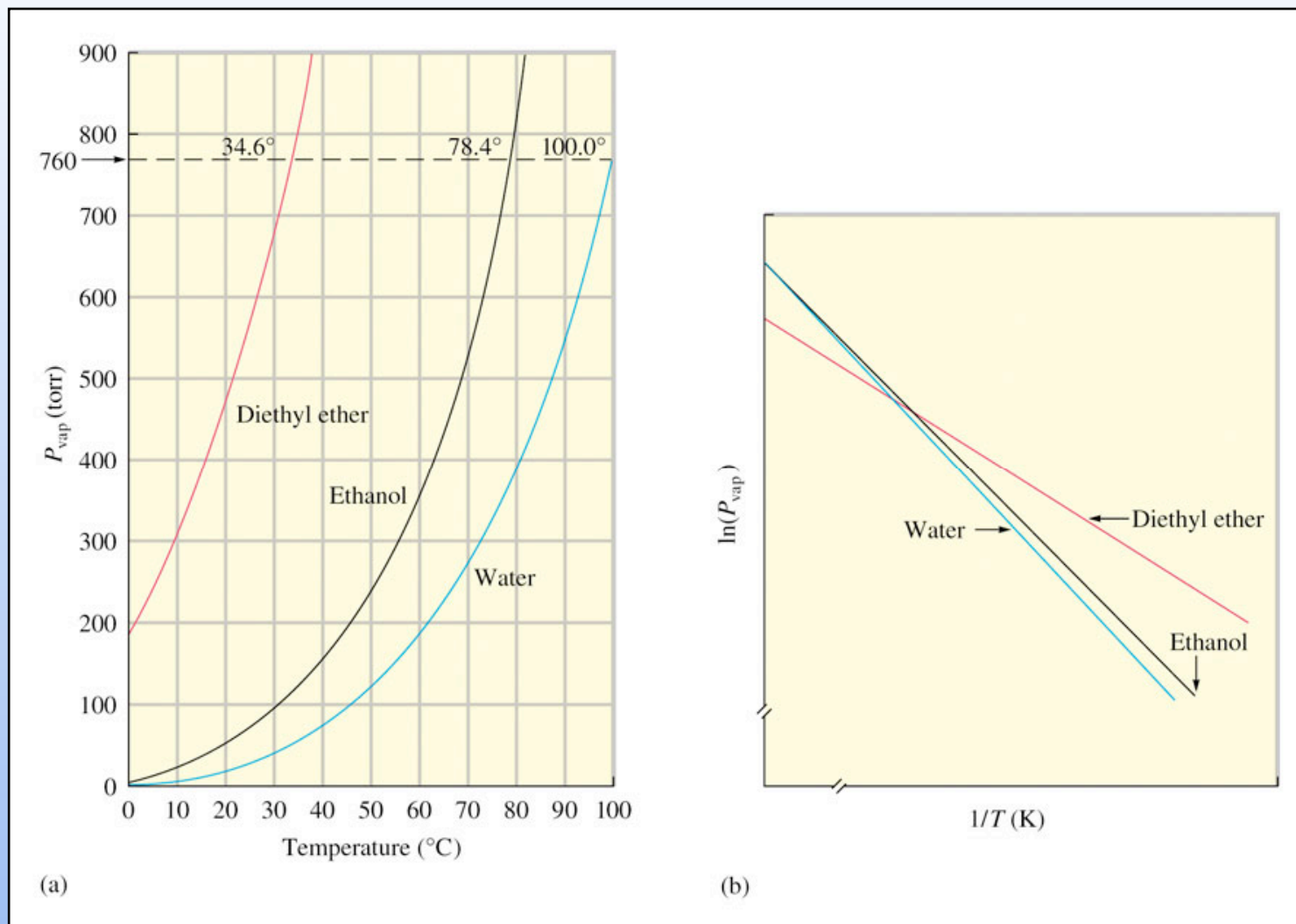


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How Does Vapor Pressure Change with T?

$$\ln\left(\frac{P_2}{P_1}\right) = -\frac{\Delta H_{vap}}{R} \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

The Clausius-Clapeyron Equation

Relates the vapor pressure P_1 at temperature T_1
to the vapor pressure P_2 at temperature T_2

What is the normal boiling point of water?

Given the vapor pressure of water at 25°C is 24 Torr
and the $\Delta H_{\text{vap}} = 40.8 \text{ kJ mol}^{-1}$

What is the boiling point?

Definition: The boiling point is temperature at which the vapor pressure is equal to prevailing pressure

What is the normal boiling point?

Definition: The normal boiling point is temperature at which the vapor pressure is equal to 1 atm

What is the normal boiling point of water?

Given the vapor pressure of water at 25°C is 24 Torr
and the $\Delta H_{\text{vap}} = 40.8 \text{ kJ mol}^{-1}$

This question is asking at what temperature is the
vapor pressure of water equal to 1 atm.

Use the Clausius-Clapeyron Equation

What is the normal boiling point of water?

Given the vapor pressure of water at 25°C is 24 Torr
and the $\Delta H_{\text{vap}} = 40.8 \text{ kJ mol}^{-1}$

Phase Transitions

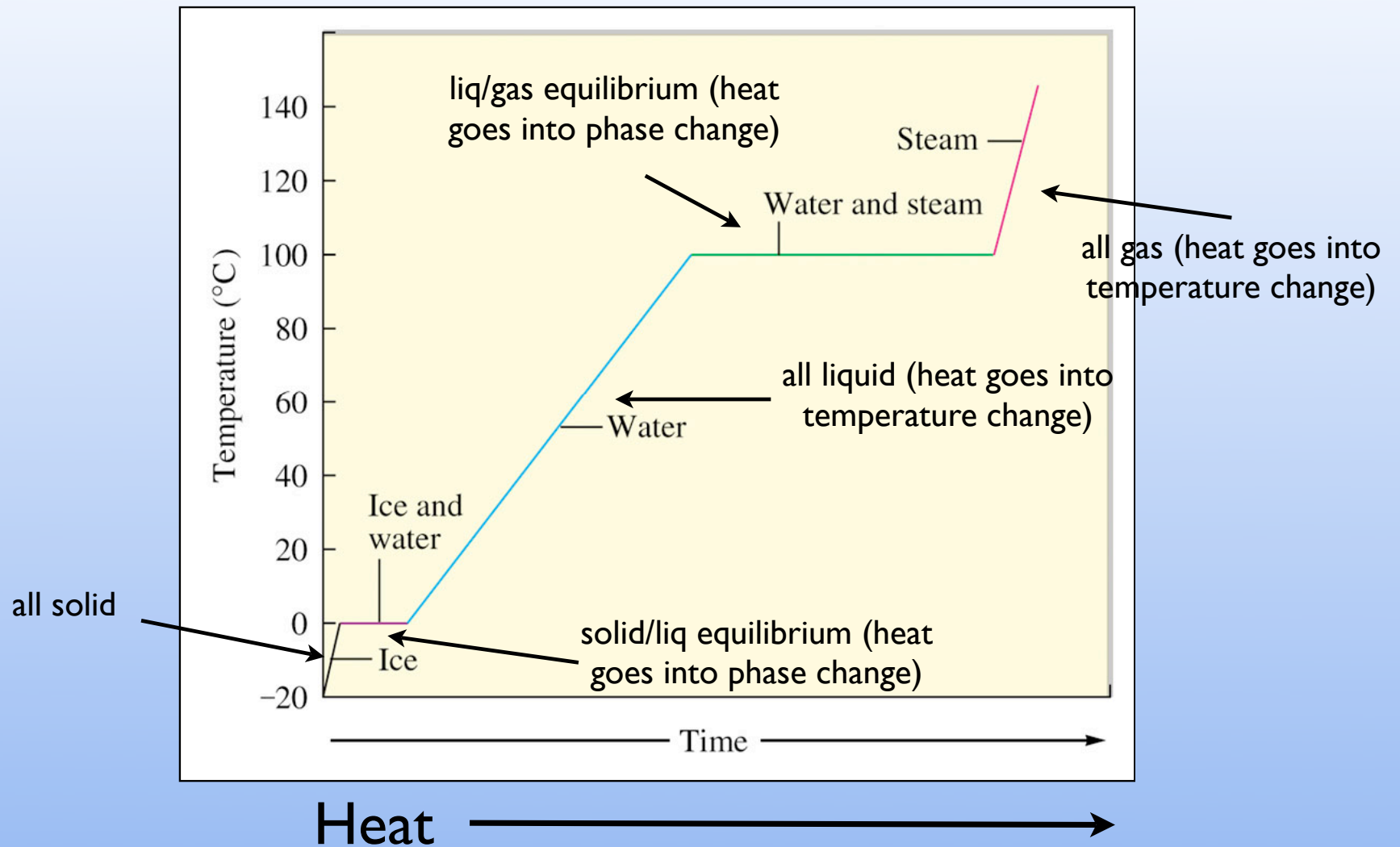


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Previous Thermo

Single Phase

energy into goes into temperature change
at constant P

$$q = \Delta H = C_p \Delta T$$

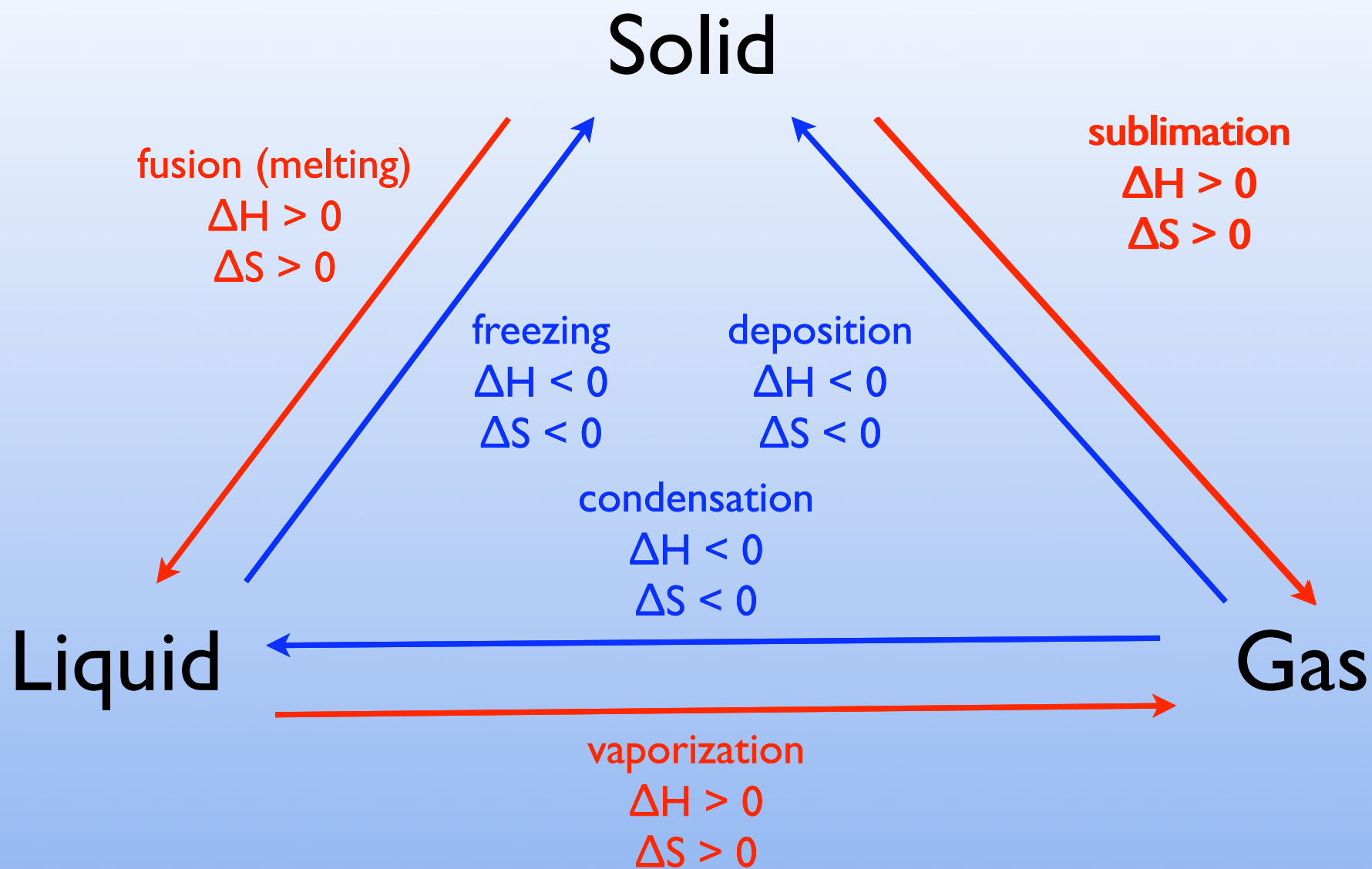
you need heat capacity of specific phase (sol, liq, gas)

Phase Change

energy into goes into phase change
(the two phases have the same free energy
but one is higher in enthalpy)

$$q = \Delta H_{\text{transition}} \text{ for example } q = \Delta H_{\text{fus}} \text{ for melting}$$

The different phase transitions

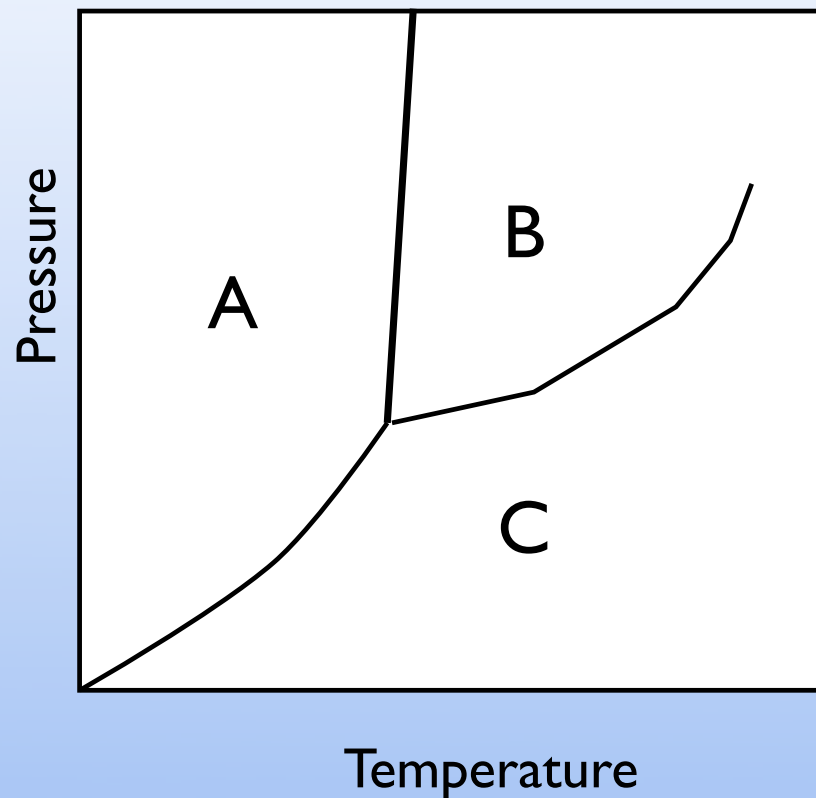


Phase Diagrams

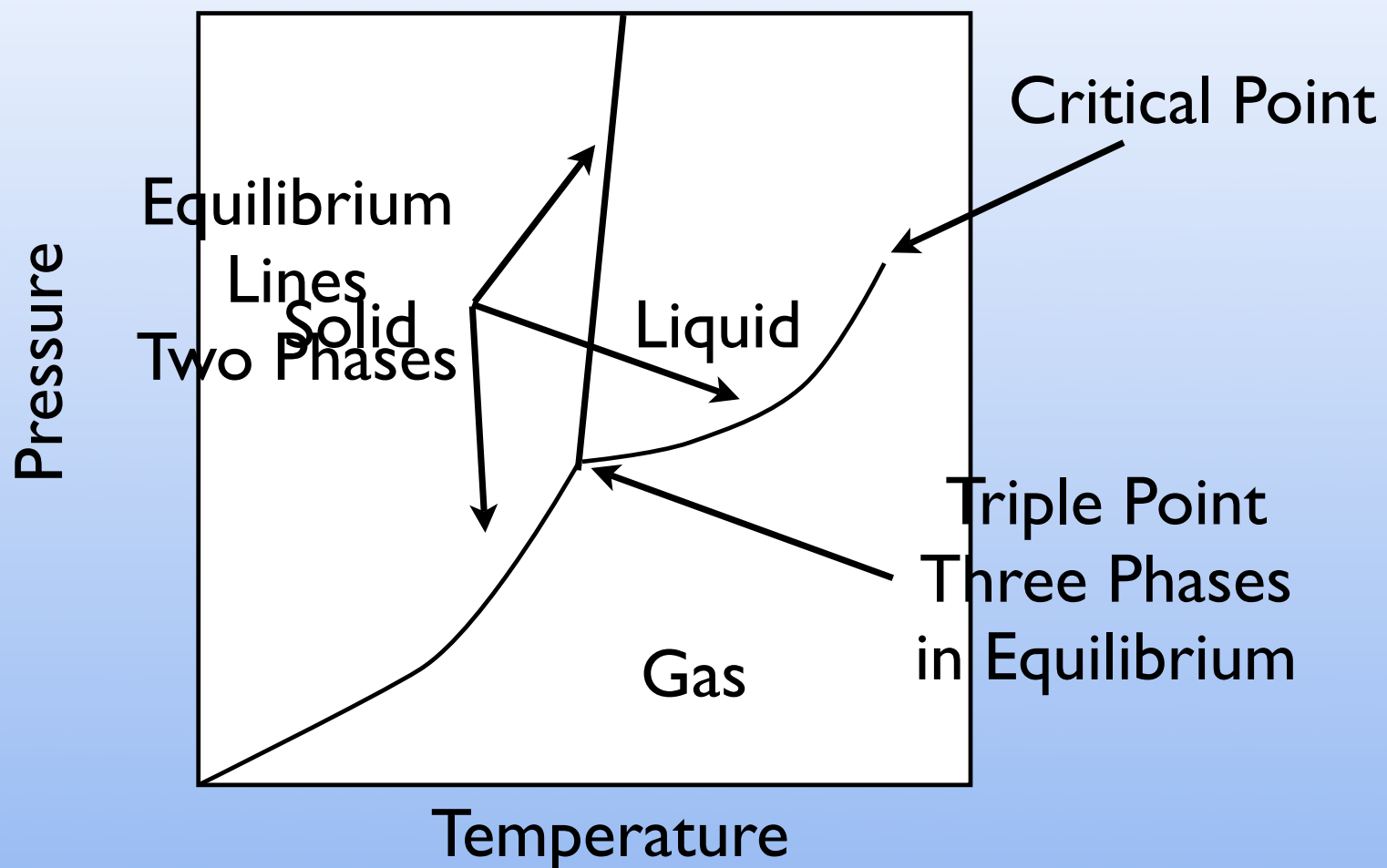
The diagram on the right shows different phases for a compound as a function of temperature and pressure

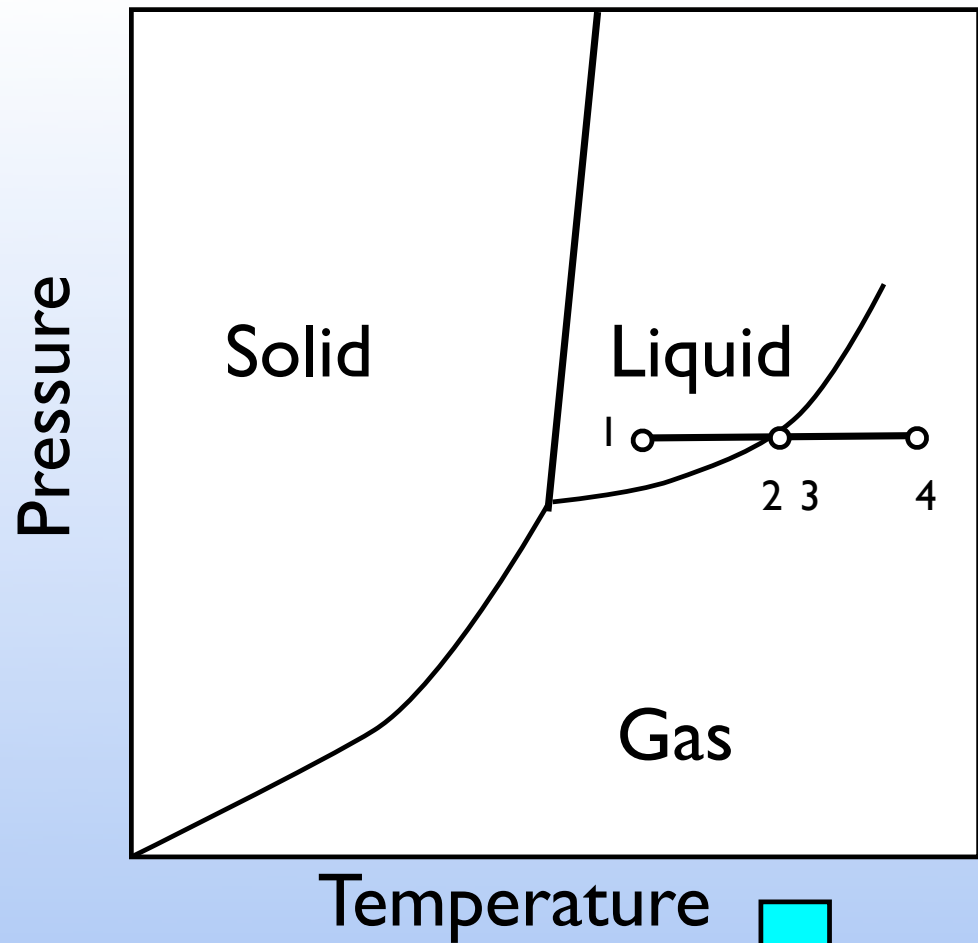
What is the phase labeled "A"?

- A. solid
- B. liquid
- C. gas
- D. no way to know



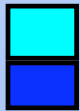
Important Points





1

all liquid



2

liquid and gas



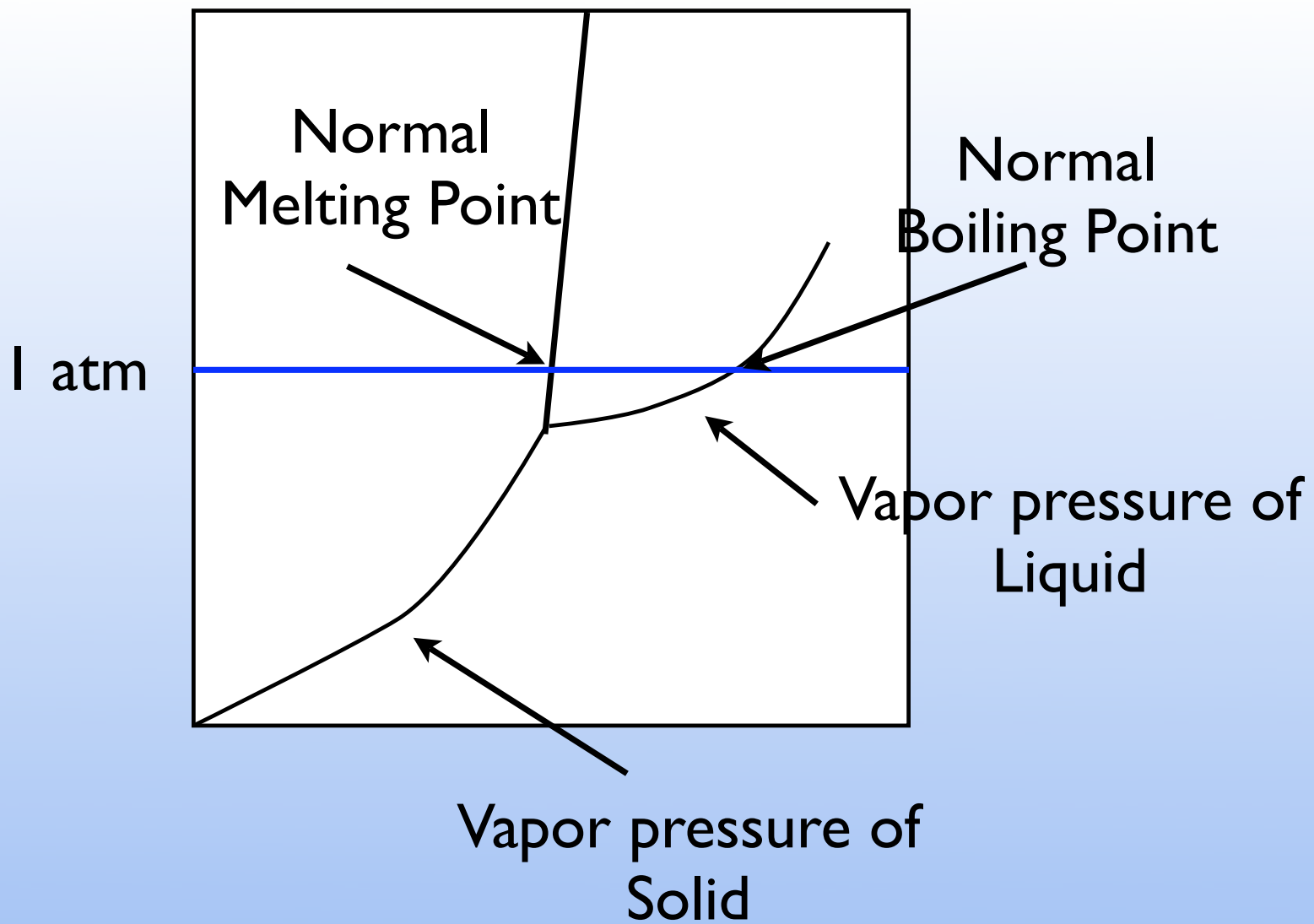
3

liquid and gas



4

all gas



Phase Diagram of CO₂

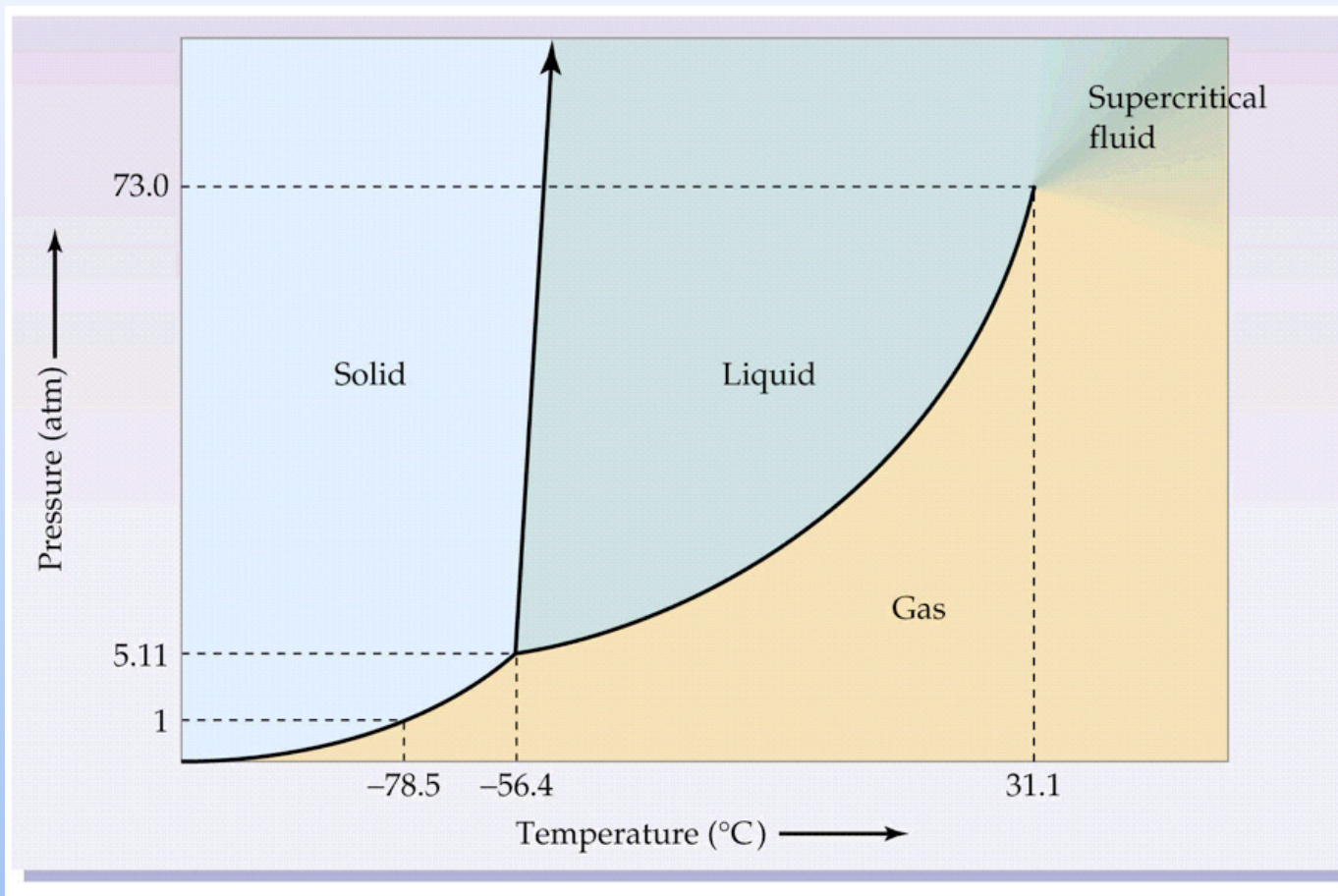


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Phase Diagram of Water

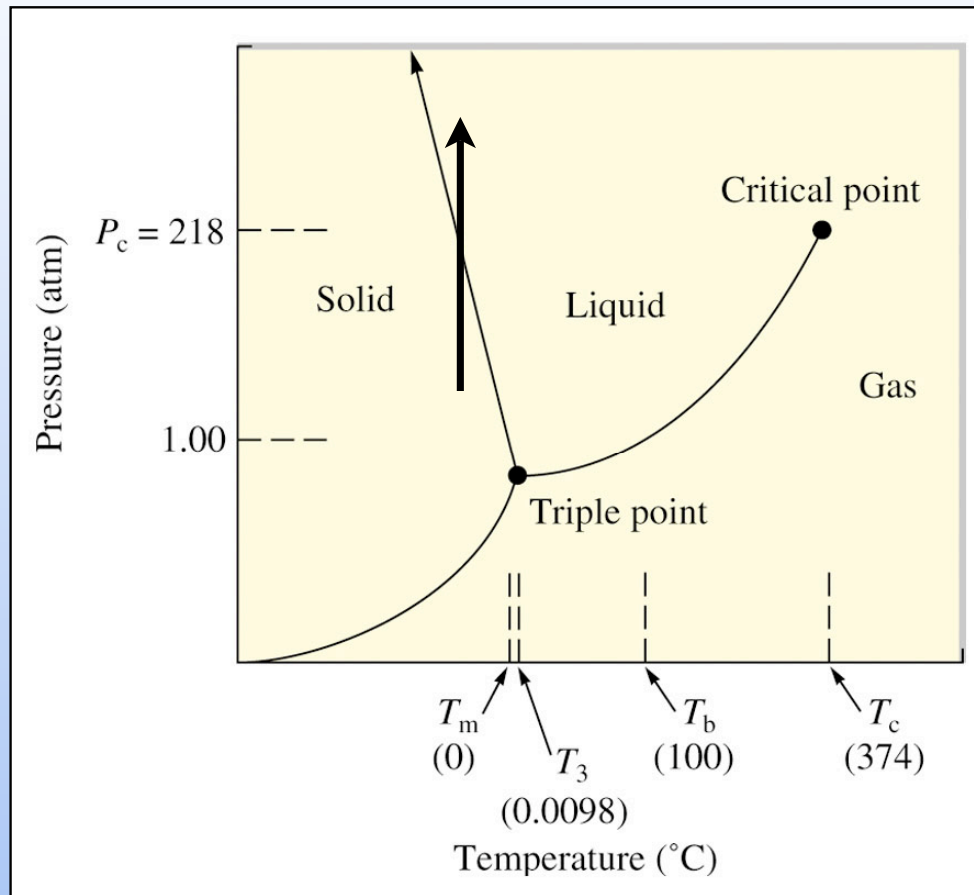
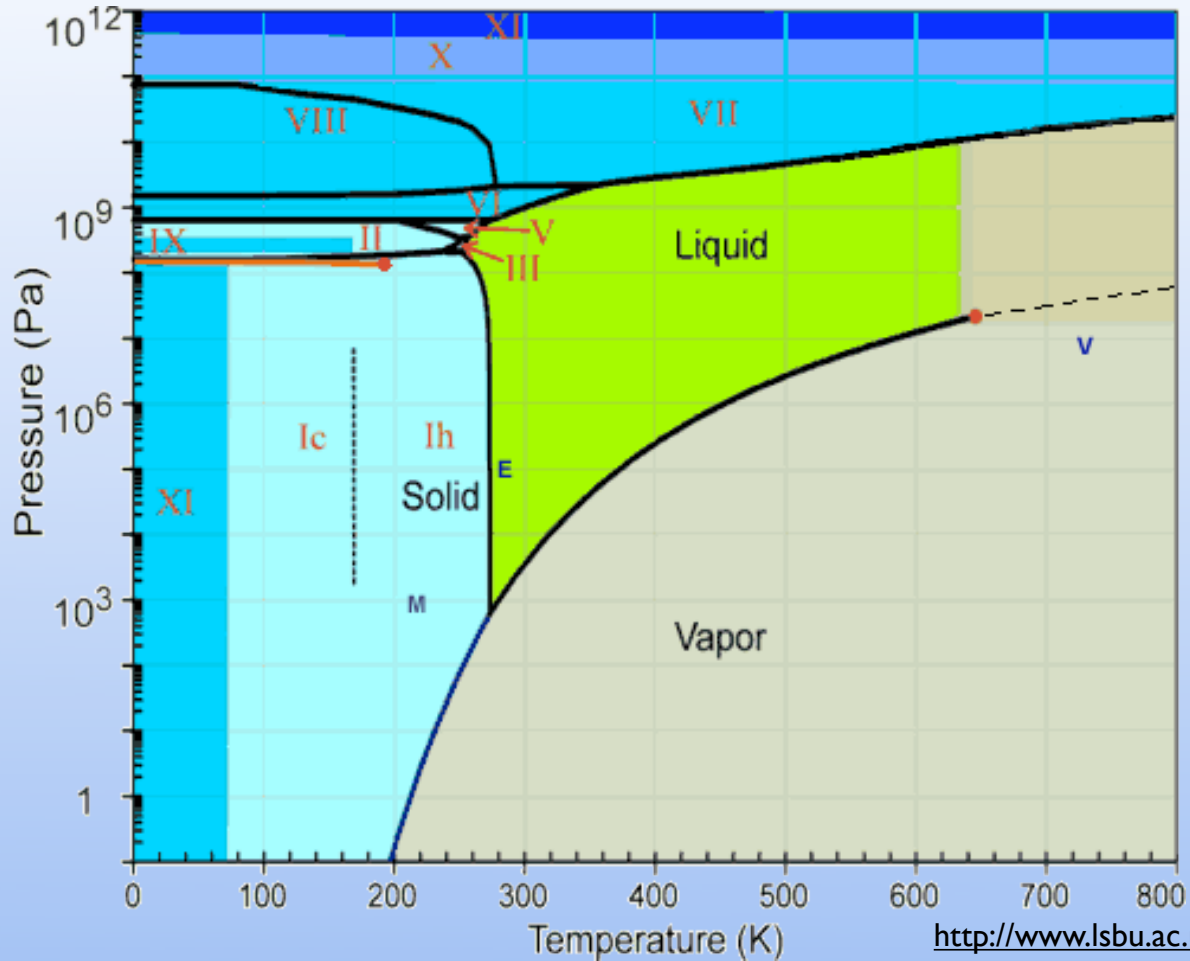


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At a constant temperature, increasing the pressure will cause ice to melt
(it moves to the higher density phase which for water is a liquid)

Phase Diagram of Water



Many different solid phases. At very high pressure the liquid will solidify

Other Substances

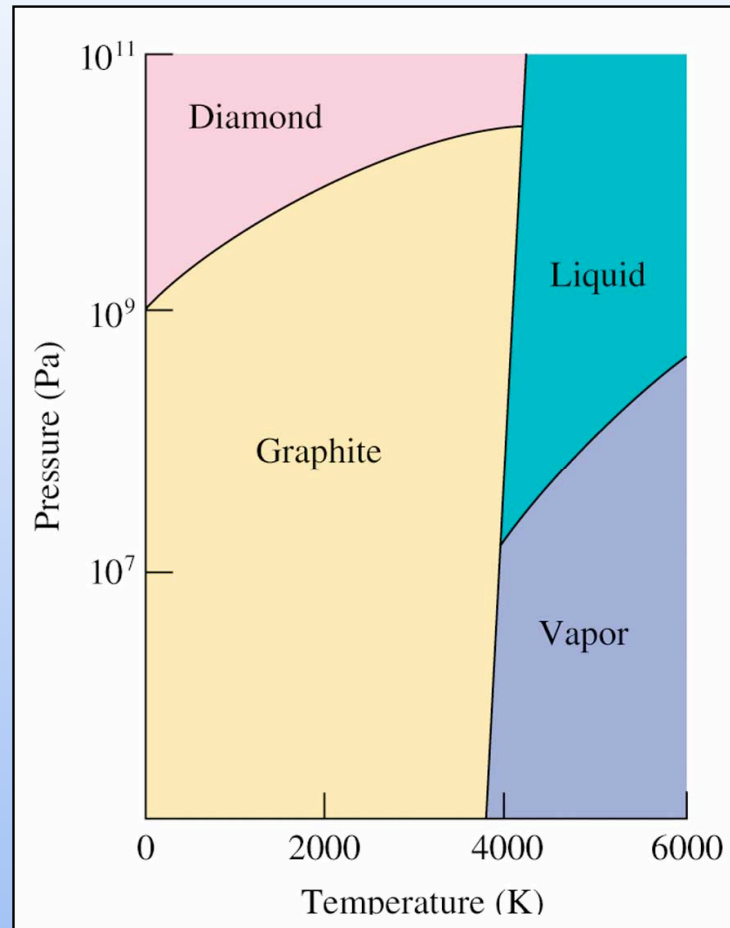


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