CH_3

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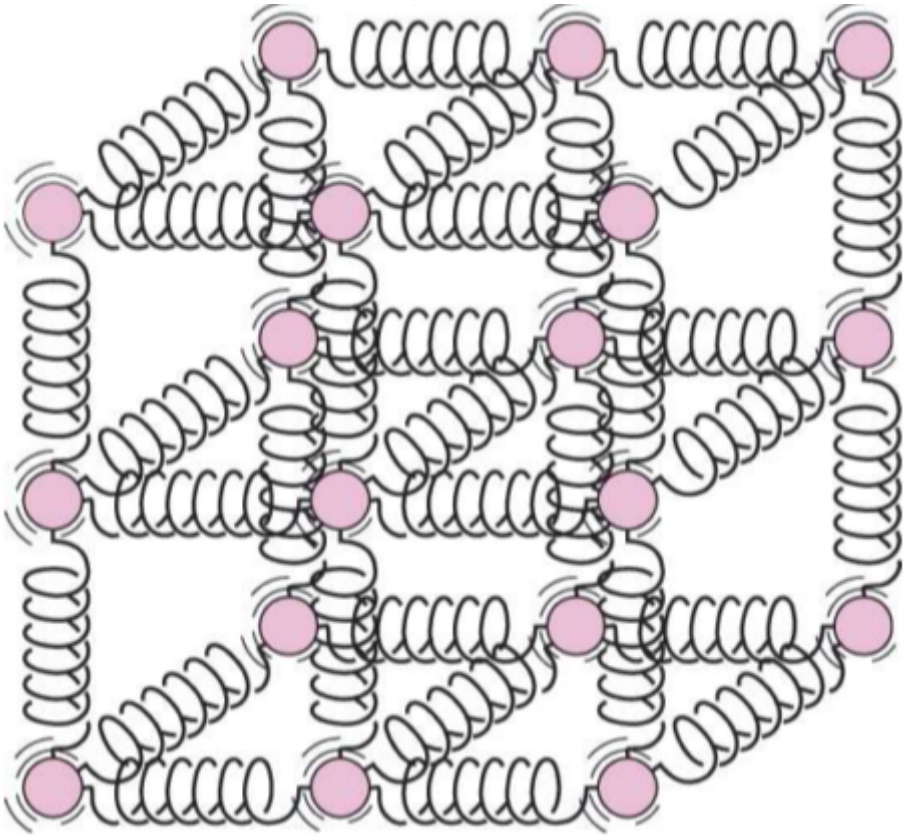
3.1 Pure Substance

Definition

a substance that has a fixed chemical composition throughout

3.2 Phases of a Pure Substance

Intermolecular Model



Solid

molecules: in fixed positions

intermolecular force: strong

Liquid

molecules: no longer at fixed positions and can rotate and translate freely

intermolecular force: weaker

distance between molecules: slight increase comparing to solid

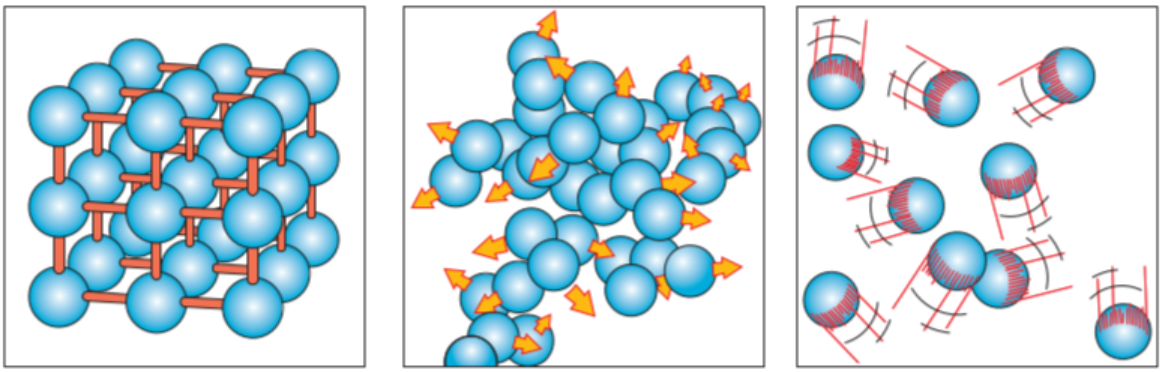
exception on water

Gas

molecules: orders are nonexistent and move at random

intermolecular force: vary small

Energy Level: higher than other phases



(a) (b) (c)

3.3 Phase-Change Processes of Pure Substances

Compressed Liquid and Saturated Liquid

- **compressed liquid**: liquid exists in liquid phase
- **saturated liquid**: liquid about to vaporize

FIGURE 3–5
At 1 atm and 20°C, water exists in the liquid phase (*compressed liquid*).

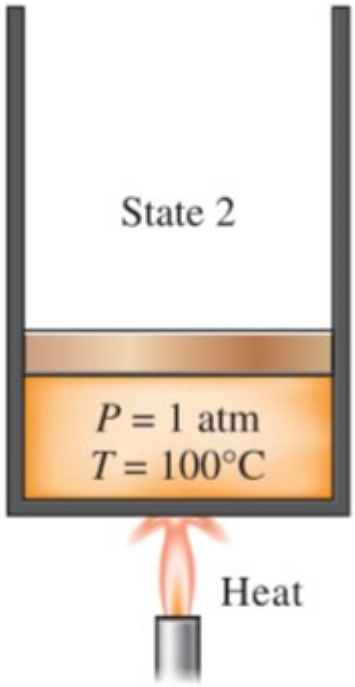


FIGURE 3–6
At 1 atm pressure and 100°C, water exists as a liquid that is ready to vaporize (*saturated liquid*).

Saturated Vapor and Superheated Vapor

- **saturated vapor**: vapor is about to condense
- **superheated vapor**: vapor is not about to condense

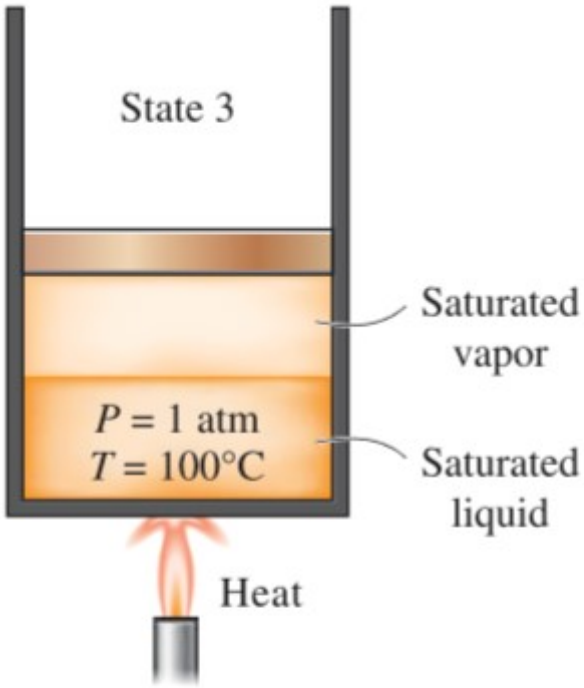


FIGURE 3–7
As more heat is transferred, part of the saturated liquid vaporizes (*saturated liquid–vapor mixture*).

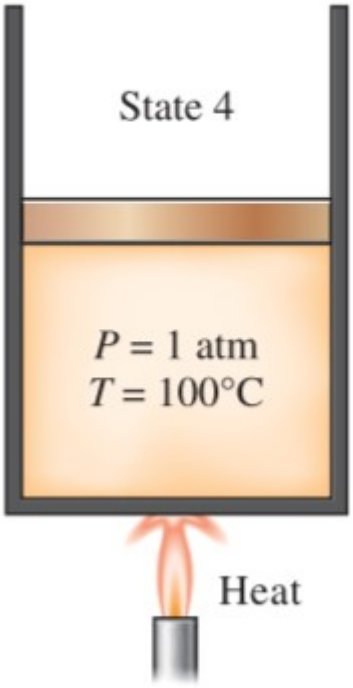


FIGURE 3–8

At 1 atm pressure, the temperature remains constant at 100°C until the last drop of liquid is vaporized (*saturated vapor*).

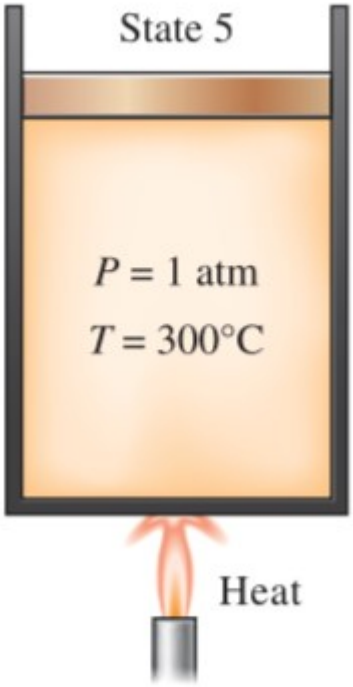


FIGURE 3–9
As more heat is transferred, the temperature of the vapor starts to rise (*superheated vapor*).

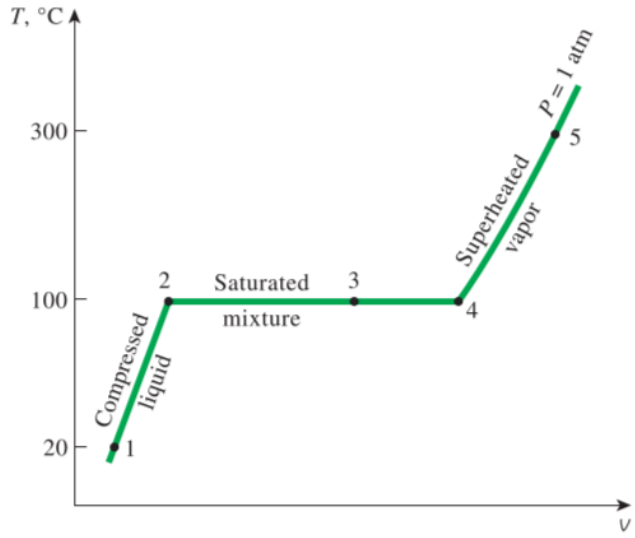
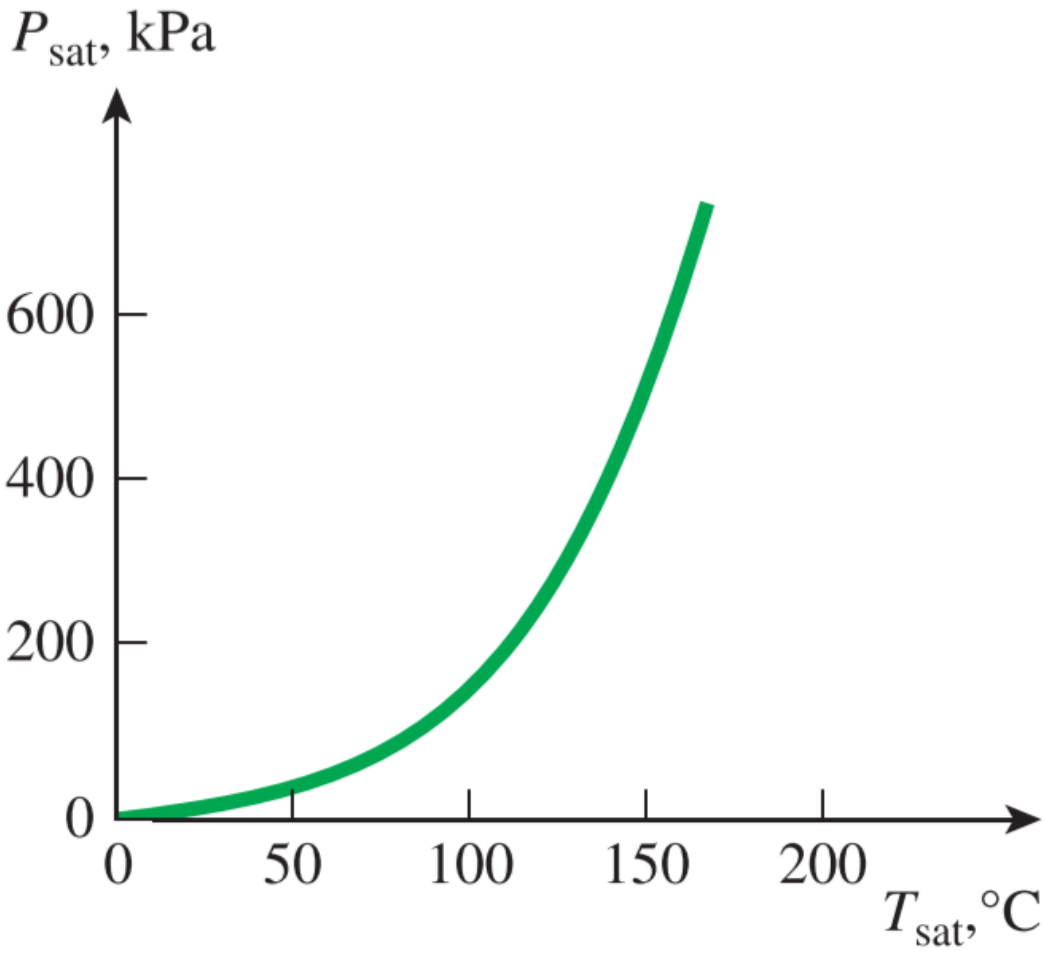


FIGURE 3–10
T-*v* diagram for the heating process of water at constant pressure.

Saturation Temperature and Saturation Pressure

- Saturation Temperature: T_{sat}
- Saturation Pressure: P_{sat}



Latent Heat

- **latent heat of fusion**: the amount of energy absorbed(released) during melting(freezing)
- **latent heat of vaporization**: the amount of energy absorbed(released) during vaporization(condensation)