What is a phase diagram?

Worksheet

Phase diagrams show three equilibrium curves-melting, boiling, and sublimation-where phases coexist. The triple point is where all three phases meet; the critical point is where liquid-gas distinction vanishes.

Questions

1. At the triple point of CO (56.6C, 5.1 atm), what phases are present?

A) Only solid and liquid
B) Only liquid and gas
C) Solid, liquid, and gas
D) Only solid

2. If pressure increases along a vertical line on a phase diagram at constant temperature, what happens?

A) Phase always stays the same
B) May transition from gas liquid solid
C) May transition from solid gas directly
D) Gas always forms

3. The critical point on a phase diagram marks

A) Where solid becomes liquid
B) The highest P, T where liquid-gas boundary exists
C) Where sublimation occurs
D) Where melting stops

4. Why does dry ice (solid CO) sublimate at room temperature and 1 atm?

A) CO has no liquid phase at 1 atm
B) Sublimation curve is below room temperature at 1 atm
C) Room temperature is above the critical point
D) All solids sublimate at 1 atm

5. Water has a triple point at 0.01C and 0.006 atm. What does this mean physically?

6. The boiling point of water is 100C at 1 atm but 98C at 0.9 atm. Why?

7. At very high pressure, water remains liquid even above 100C. Where on the phase diagram does this occur?

8. Define: What is a phase diagram?

9. Define: What is the triple point?

10. Define: What is the critical point?

Answer Key

1. C) Solid, liquid, and gas - Triple point is where all three phases coexist in equilibrium.

2. B) May transition from gas liquid solid - Increasing pressure at constant T pushes the system toward denser phases: gas liquid solid.

3. B) The highest P, T where liquid-gas boundary exists - Above the critical point, the liquid-gas boundary disappears and a supercritical fluid exists.

4. B) Sublimation curve is below room temperature at 1 atm - CO phase diagram shows the sublimation curve (solid-gas) is the only stable path at 1 atm below ~78C.

5. At this unique point, solid ice, liquid water, and water vapor coexist in equilibrium No other combination of P and T allows all three phases together Small changes in P or T shift the system to one dominant phase

6. Boiling point depends on external pressure (follows the liquid-gas curve on phase diagram) Lower pressure allows vapor pressure to reach equilibrium at lower temperature This is why water boils at lower temperatures at high altitudes

7. Above 1 atm on the phase diagram, along the liquid-gas curve Water can exist as liquid up to the critical point (~374C, ~218 atm) Above critical pressure, there's no phase boundary-supercritical fluid forms

8. A graph showing the stability regions of solid, liquid, and gas phases as functions of pressure and temperature.

9. The unique pressure and temperature at which all three phases (solid, liquid, gas) coexist in equilibrium.

10. The highest pressure and temperature at which a distinct liquid-gas boundary exists; beyond this, no phase distinction.