

Phase Equilibria and the Phase Rule

15 Very Difficult Multiple-Choice Questions

Chapter 2
Physical Pharmacy
Questions with Model Answers

Select the single best answer for each question.

Multiple-Choice Questions

Circle the best answer.

1. A closed system contains a homogeneous gaseous mixture, two completely immiscible liquid layers, three distinct polymorphic forms of the same crystalline compound, and one homogeneous solid solution. How many phases are present?

- A. 5 phases
- B. 6 phases
- C. 7 phases
- D. 8 phases

2. Which statement most accurately describes the graphical meaning of a line separating two regions in a one-component pressure-temperature phase diagram?

- A. It represents a single phase with two independently variable intensive properties.
- B. It represents the coexistence of two phases in equilibrium.
- C. It represents three phases in equilibrium at all points along the line.
- D. It represents a region in which composition changes continuously.

3. Why does increasing pressure favor liquid water rather than ice near their equilibrium boundary?

- A. Ice has greater molecular compactness than liquid water.
- B. Liquid water has a lower vapor pressure than ice at every temperature.
- C. Ice is less dense than liquid water, so pressure favors the more compact liquid phase.
- D. Pressure decreases the intermolecular forces within the solid structure.

4. Which combination correctly matches the curves of a one-component phase diagram as presented in the chapter?

- A. OA: sublimation curve; OB: vapor-pressure curve; OC: melting-point curve
- B. OA: melting-point curve; OB: sublimation curve; OC: vapor-pressure curve
- C. OA: vapor-pressure curve; OB: melting-point curve; OC: sublimation curve
- D. OA: critical-pressure curve; OB: freezing curve; OC: boiling curve

5. A substance is maintained at a temperature and pressure above its critical point. Which description is most appropriate?

- A. It exists as two distinguishable phases with identical compositions.
- B. It must exist exclusively as a highly compressed liquid.
- C. It forms a supercritical fluid in which distinct liquid and gas phases do not exist.
- D. It exists at the triple point because all phase boundaries terminate there.

6. Which property combination makes supercritical fluids particularly useful for extraction processes?

- A. Liquid-like viscosity and gas-like density
- B. Gas-like viscosity together with liquid-like density and solvent power
- C. Solid-like density together with liquid-like viscosity
- D. Gas-like solvent power together with negligible molecular mobility

7. For a one-component system at the triple point, what is the correct interpretation according to the Gibbs phase rule?

- A. $F = 2$; temperature and pressure may be changed independently.
- B. $F = 1$; either temperature or pressure must remain constant.
- C. $F = 0$; neither temperature nor pressure may be independently varied without changing the number of phases.
- D. $F = 3$; the compositions of all three phases must be specified.

8. A one-component system lies exactly on its liquid-vapor equilibrium curve but not at either the triple point or critical point. How many degrees of freedom does it possess?

- A. Zero
- B. One
- C. Two
- D. Three

9. A condensed two-component system contains one solid phase and one liquid phase in equilibrium. What is the number of degrees of freedom?

- A. Zero
- B. One
- C. Two
- D. Three

10. For a two-component liquid system containing only one phase, which statement is correct when pressure is not fixed?

- A. Only composition is required to define the system.
- B. Temperature and pressure are sufficient because composition is fixed by the phase rule.
- C. Three independent variables may be required: temperature, pressure, and composition.
- D. Four independent variables are required because each component contributes two compositions.

11. In a two-component liquid system at fixed pressure, a composition-temperature point lies inside the binodal curve and below an upper consolute temperature. What is the most appropriate interpretation?

- A. A single homogeneous liquid phase must exist.
- B. Two liquid phases of different compositions coexist.
- C. Two pure solid phases coexist without a liquid phase.
- D. The mixture is necessarily at its eutectic composition.

12. What is the principal function of a tie line in a partially miscible two-liquid phase diagram?

- A. It connects the melting points of the two pure components.
- B. It identifies the critical pressure of the mixture.
- C. It connects the compositions of the two conjugate liquid phases that coexist at a specified temperature.
- D. It gives the overall composition of every single-phase mixture.

13. Which statement correctly describes a binary eutectic point?

- A. It is the temperature at which the two pure components have identical melting points.
- B. It is a point where one solid phase and one vapor phase coexist.
- C. It is a point where solid 1, solid 2, and a liquid solution are in mutual equilibrium.
- D. It is the maximum temperature at which the two components form a homogeneous liquid.

14. For a three-component system, both temperature and pressure are fixed. Assuming that only one phase is present, how many independent composition variables are required to define the system?

- A. One
- B. Two
- C. Three
- D. Four

15. Which statement about a triangular composition diagram is correct?

- A. Each side represents mixtures containing all three components in equal proportions.
- B. Each corner represents 100% by weight of one component, while points inside the triangle represent ternary mixtures.
- C. The center of the triangle always represents a two-phase system.
- D. A point located on one side represents a pure single component.

Model Answer Key

The correct option for each question is shown below.

Question 1: C	Question 2: B	Question 3: C
Question 4: C	Question 5: C	Question 6: B
Question 7: C	Question 8: B	Question 9: B
Question 10: C	Question 11: B	Question 12: C
Question 13: C	Question 14: B	Question 15: B

End of Questions