PHYS 758 – Statistical Physics

Reading Quiz 8: Chapter 12 (Pathria & Beale), Secs. 7-11

1. *Singularities* in physical quantities of a system at the critical point can be expressed as _____, characterized by a set of _____.

2. Write down the mathematical relations for the limiting values of the order parameter m_0, the susceptibility χ_0, and the specific heat C_V as a function of temperature T (or of $t \equiv T - T_c$) near the critical point.

3. In what way is a gas-liquid system (fluid), governed by the van der Waals theory, the same as a magnetic system in the mean field approximation near the critical point?

4. What three characteristics of a system tend to determine the behavior of thermodynamic quantities near the critical point?

5. State two *thermodynamic inequalities* (mathematical expressions) that restrict possible values of critical exponents and identify the exponents.

6. To what class of phase transition does *Landau's phenomenological theory* of phase transitions apply? What are the central quantities in the theory?

7. How does Landau's theory of phase transitions relate to the mean field theory of magnetic systems or the van der Waals theory of a fluid? What quantities are the same between the theories?

8. What properties of a system determine its *universality class* and what is the physical significance of universality classes?

9. State the *scaling hypothesis* for the thermodynamic equation of state and for the free energy of a system and explain its physical significance.

10. Explain what gives rise to the phenomenon of *critical opalescence* when radiation (e.g., visible light) is scattered off a system near the critical point.