

YOUR NAME: _____

Physics 831 Quiz #9 - Wednesday, Nov. 27
OPEN BOOK, OPEN NOTES, CLOSED MOUTH

In-class students: work in pairs for 55 minutes.
Take-home students: work individually for 80 minutes.

1. Assume the free energy for a complex field in ONE dimensions is given by:

$$F = \int dx \frac{1}{2} \left(A |\phi|^2 + \kappa |\partial_x \phi|^2 \right).$$

Define the correlation Γ as

$$\Gamma(x) \equiv \langle \phi^*(0) \phi(x) \rangle.$$

Fourier transforms in one dimensions are defined by:

$$\tilde{\phi}_k \equiv \frac{1}{\sqrt{L}} \int dx e^{ikx} \phi(x), \quad \phi(x) = \frac{1}{\sqrt{L}} \sum_k e^{-ikx} \phi_k.$$

- (a) Calculate $\Gamma(x)$.
(b) Derive the critical exponent ν ?
The correlation length ξ behaves as $\xi \sim t^{-\nu}$ as $t = (T - T_c)/T_c \rightarrow 0$.

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2. The grand canonical partition function for a system of charged particles,

$$Z = \text{Tr} e^{-\beta H + \beta \mu Q},$$

is given by:

$$\ln Z = A(T) \cosh(\mu/T).$$

In terms of μ , T , A , and derivatives of A ,

- (a) What is the average charge $\langle Q \rangle$?
- (b) What is the fluctuation of the charge $\langle Q^2 - \langle Q \rangle^2 \rangle$?