IISER Mohali

[Session 2018-19, Even Semester]

PHY 304 (Statistical Mechanics)

Quiz # 1

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1. A tall cylindrical vessel with gaseous nitrogen is located in a uniform gravitational field in which the free-fall acceleration is equal to g. The temperature of the nitrogen varies along the height h so that its density is the same throughout the volume. The variation in temperature with respect to the height is given by,

   (a) gM/R
   (b) $-gM/R$
   (c) $2gM/R$
   (d) $-2gM/R$

   M is the molar mass of the nitrogen. You can treat the gas as ideal.

2. Which of the following statement/s are wrong ?

   (a) $\Delta Q = 0$ implies $\Delta S = 0$.
   (b) According to the condition for stable equilibrium the entropy should decrease in any small change.
   (c) The third law of thermodynamics implies that $\lim_{T\to 0} \frac{\partial S}{\partial V} = 0$.
   (d) No engine other than Carnot engine can be 100% efficient.

3. Given $U = U(S, V, N)$, the Maxwell relation $(\partial S/\partial \mu)_{T,V} = (\partial N/\partial T)_{\mu,V}$ follows from the thermodynamic potential/s

   (a) $F = U - TS$
   (b) $\Phi_G = U - TS - \mu N$
   (c) $H = U + PV$
   (d) $G = U + PV - TS$

4. Given $U = U(S, V, N)$ and $F = U - TS$, which of these is/are true if $\partial^2 F/\partial V^2 \geq 0$?

   (a) $\kappa_T > 0$
   (b) $c_P > 0$
   (c) $\kappa_S > 0$
   (d) $c_V > 0$

5. The Legendre Transform of $f(x) = \ln(x)$ is given by

   (a) $c(m) = -e^m$
   (b) $c(m) = \ln(m) - 1$
   (c) $c(m) = e^{-m}$
   (d) $c(m) = -\ln(m) - 1$