PHYSICS EXAMINATION PROBLEMS
SOLUTIONS AND HINTS FOR STUDENT SELF-STUDY

Module Code	PHY2201
Name of module	Statistical Physics
Date of examination	Jan 2004

1. i) see course notes

   ii) 5×10^{-6}

   iii) see course notes

2 see course notes

e.g. Entropy, Volume, particle number, Free Energy, Gibbs Free Energy, Enthalpy, Heat Capacity (all extensive)

e.g. pressure, temperature, mass density, particle number density, specific heat capacity, chemical potential (all intensive)

see course notes

$$\Delta S = nR\ln\left(\frac{V_1+V_2}{V_1}\right)$$

$$\Delta S = \int_{\text{initial}}^{\text{final}} \frac{d'Q}{T}$$ only for reversible changes

3. Hint. The density of states factor is $2\pi v dv$ Normalisation requires $\int_0^\infty p(v)dv = 1$

Hint. $\langle\varepsilon\rangle = \int_0^\infty p(\varepsilon)\varepsilon d\varepsilon = \int_0^\infty p(v)\left(\frac{1}{2}mv^2\right)dv$

Yes. See course notes

4. i) see course notes

   ii) $\eta = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$. $\eta > \eta_{rev}$ violates Kelvin's statement of second law if reversible engine is used in reverse as a heat pump to restore reservoirs used by irreversible engine (see course notes).

   iii) 3.78×10^3 J; zero JK^{-1}

5. $S = k_B \ln\Omega$

   a) zero b) $k_B \ln5$ c) $k_B \ln30$

   macrostate c)

   see course notes