

Phy 410

Quiz #2, Jan 30, 2009

Two systems S_1 ($N_1=100$, $U_1=100$) and S_2 ($N_2=200$, $U_2=20$) are not in thermal contact initially. The number of microstates accessible to S_1 is g_1 and to S_2 is g_2 .

a) What is the number of microstates accessible to the combined system S_2+S_1
 g ? (2 points)

$g=g_1 \times g_2$ There is no contact. So there is no exchange of energy between the two systems

b) Now the two systems are brought into thermal contact and they come to thermal equilibrium. (3 points)

Which of the following statements are true?

- i) g will decrease
- ii) g will remain constant
- iii) g will increase (True)

In the beginning the two systems have different temperatures, because

$\frac{U_1}{N_1} = 1$ and $\frac{U_2}{N_2} = \frac{1}{10}$. So when brought into contact they will

exchange energy, keeping the total energy constant, and approach equilibrium. In this process the entropy increases so g will increase.

c) What are the energies of the two systems when they are in thermal equilibrium? (5 points)

Now the two systems are in thermal equilibrium. They have the same temperature τ .

$$\frac{\bar{U}_1}{N_1} = \frac{\bar{U}_2}{N_2} \text{ with the condition } \bar{U}_1 + \bar{U}_2 = U_{tot} = U_1 + U_2 = 120$$

Knowing N_1 and N_2 we get $\bar{U}_1 = 40$ and $\bar{U}_2 = 80$