

NAME(S):

First Matlab Exercise for Physics 622

Winter quarter 2008

In this exercise you will study the N -level system, $E_n = n\epsilon$, $n = 0, 1, \dots, N-1$. We want to produce plots of Z and U and study their dependence on temperature and N . The expressions we need are: $Z = \sum_0^{N-1} e^{-nx} = \frac{1-e^{-Nx}}{1-e^{-x}}$, $U = \frac{1}{Z} \sum_0^{N-1} (n\epsilon)e^{-nx} = -\frac{d}{d\beta} \ln(Z)$, where $x = \beta\epsilon$. You're given expressions for $N = 5$.

1. Start MATLAB
2. Produce a vector of values of x at which we will want Z and U , a vector of values of n for the sums, and a vector of values of e^{-x} :

```
xvec=0.1:0.1:5.0  
nvec=0:1:4  
expvec=exp(-xvec)
```

3. Next produce a matrix that leads to the explicit terms we need for the sum:

```
[expmat,nmat]=meshgrid(expvec,nvec)  
summandvec=expmat.^nmat
```

4. Sum over the columns to produce Z and plot the result:

```
Z=sum(summandvec)  
plot(Z,xvec)
```

5. Now play around. Can you figure out how U will behave from the plot of Z ? What is the specific heat, dU/dT ? Change the summand to compute U numerically. How do Z and U change as N increases?