b)

We have found the Grand Partition Function to be:

In[15]:=
```
Z[β_] = 4 π/n! (2 π m/(β h^2))^(3 n/2) Exp[μ β n] (Sinh[H β μ0]/(H β μ0))^n;
```

The Grand Potential is given by:

$\Omega = \frac{-1}{\beta} \mathrm{Ln}(Z)$

Expanding out all of the terms we get:

In[27]:=
```
Ω[β_] = Expand[PowerExpand[-1/β Log[Z[β]]]]
```

Out[27]=
$$-n\,\mu - \frac{2\,\mathrm{Log}[2]}{\beta} - \frac{3\,n\,\mathrm{Log}[2]}{2\,\beta} + \frac{3\,n\,\mathrm{Log}[h]}{\beta} + \frac{n\,\mathrm{Log}[H]}{\beta} - \frac{3\,n\,\mathrm{Log}[m]}{2\,\beta} - \frac{\mathrm{Log}[\pi]}{\beta} - \frac{3\,n\,\mathrm{Log}[\pi]}{2\,\beta} + \frac{5\,n\,\mathrm{Log}[\beta]}{2\,\beta} + \frac{n\,\mathrm{Log}[\mu 0]}{\beta} + \frac{\mathrm{Log}[n!]}{\beta} - \frac{n\,\mathrm{Log}[\mathrm{Sinh}[H\,\beta\,\mu 0]]}{\beta}$$

c)

Finding the magnetism:

$M = -\frac{\partial \Omega}{\partial H} = -\frac{\partial}{\partial H}\left(\frac{n\,\mathrm{Log}[H]}{\beta} - \frac{n\,\mathrm{Log}[\mathrm{Sinh}[H\,\beta\,\mu 0]]}{\beta}\right)$

$M = -\frac{n}{H\beta} + n\,\mu 0\,\mathrm{Coth}[H\,\beta\,\mu 0]$