Fisica Estadistica
Tarea 2

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Contents

Chapter 1

1.1

En este caso simplemente tenemos que despejar:

$$
\begin{aligned}
S(N,V,E) &= Nk\ln\left[\frac{V}{h^3}\left(\frac{4\pi mE}{3N}\right)^{\frac{3}{2}}\right]+\frac{3}{2}Nk\\
S &= Nk\ln\left[\frac{V}{h^3}\left(\frac{4\pi mE}{3N}\right)^{\frac{3}{2}}\right]+\frac{3}{2}Nk\\
S &= \ln\left[\left(\frac{V}{h^3}\left(\frac{4\pi mE}{3N}\right)^{\frac{3}{2}}\right)^{Nk}\right]+\frac{3}{2}Nk\\
e^S &= e^{\ln\left[\left(\frac{V}{h^3}\left(\frac{4\pi mE}{3N}\right)^{\frac{3}{2}}\right)^{Nk}\right]+\frac{3}{2}Nk}\\
e^S &= \left(\frac{V}{h^3}\right)^{Nk}\left(\frac{4\pi mE}{3N}\right)^{\frac{3}{2}Nk}e^{\frac{3}{2}Nk}\\
e^S\left(\frac{V}{h^3}\right)^{-Nk}e^{-\frac{3}{2}Nk} &= \left(\frac{4\pi mE}{3N}\right)^{\frac{3}{2}Nk}\\
\left(e^S\left(\frac{V}{h^3}\right)^{-Nk}e^{-\frac{3}{2}Nk}\right)^{\frac{2}{3Nk}} &= \left(\frac{4\pi mE}{3N}\right)\\
e^{\frac{2S}{3Nk}}\left(\frac{V}{h^3}\right)^{-\frac{2}{3}}e^{-1} &= \left(\frac{4\pi mE}{3N}\right)\\
E &= e^{\frac{2S}{3Nk}}\frac{h^2}{V^{\frac{2}{3}}}e^{-1}\left(\frac{3N}{4\pi m}\right)\\
E &= e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right).
\end{aligned}
$$

1.2

Para este caso vamos a usar:

$$E = e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)$$

$$T = \frac{\partial E}{\partial S}$$

$$T = \left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)e^{-1}\frac{\partial e^{\frac{2S}{3Nk}}}{\partial S}$$

$$T = \left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)e^{-1}\frac{2}{3Nk}e^{\frac{2S}{3Nk}}$$

$$T = \left(\frac{h^2}{k2\pi mV^{\frac{2}{3}}}\right)e^{-1}e^{\frac{2S}{3Nk}}$$

$$T\left(\frac{k2\pi mV^{\frac{2}{3}}}{h^2}\right) = e^{\frac{2S}{3Nk}-1}$$

$$E = e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)$$

$$E = T\left(\frac{k2\pi mV^{\frac{2}{3}}}{h^2}\right)\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)$$

$$E = T\left(\frac{3Nk}{2}\right)$$

$$E = \frac{3}{2}NkT.$$

1.3

Ahora desarrollemos:

$$
\begin{aligned}
E &= e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi m V^{\frac{2}{3}}}\right)\\
P &= -\frac{\partial E}{\partial V}\\
P &= -e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi m}\right)\frac{\partial V^{-\frac{2}{3}}}{\partial V}\\
P &= \frac{2}{3}e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi m}\right)V^{-\frac{5}{3}}\\
T &= \left(\frac{h^2}{k2\pi m V^{\frac{2}{3}}}\right)e^{\frac{2S}{3Nk}-1}\\
\frac{P}{T} &= \frac{\frac{2}{3}e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi m}\right)V^{-\frac{5}{3}}}{\left(\frac{h^2}{k2\pi m V^{\frac{2}{3}}}\right)e^{\frac{2S}{3Nk}-1}}\\
\frac{P}{T} &= \frac{2}{3}\frac{\left(\frac{3Nh^2}{4\pi m}\right)}{\left(\frac{h^2}{k2\pi m V^{\frac{2}{3}}}\right)}V^{-\frac{5}{3}}\\
\frac{P}{T} &= \frac{2}{3}\left(\frac{3Nh^2k2\pi m V^{\frac{2}{3}}}{4\pi m h^2}\right)V^{-\frac{5}{3}}\\
\frac{P}{T} &= \frac{4}{3}\left(\frac{3Nh^2k\pi m V^{\frac{2}{3}}}{4\pi m h^2 V^{\frac{2}{3}}}\right)V^{-1}\\
\frac{P}{T} &= (Nk)\,V^{-1}\\
PV &= NkT.
\end{aligned}
$$

1.4

$$
\begin{aligned}
C_v &= \frac{\partial E}{\partial T} \\
&= \frac{\partial \left(\frac{3}{2}NkT\right)}{\partial T} \\
&= \frac{3}{2}Nk \\
C_p &= \frac{\partial \left(E + PV\right)}{\partial T} \\
&= \frac{\partial \left(\frac{3}{2}NkT + NkT\right)}{\partial T} \\
&= \frac{\partial NkT \left(\frac{3}{2} + 1\right)}{\partial T} \\
&= \frac{\partial \frac{5}{2}NkT}{\partial T} \\
&= \frac{5}{2}Nk \\
\frac{C_p}{C_v} &= \frac{\frac{5}{2}Nk}{\frac{3}{2}Nk} \\
&= \frac{5 \cdot 2}{3 \cdot 2} \\
&= \frac{5}{3}.
\end{aligned}
$$

1.5

Para este caso necesitamos

$$
\begin{aligned}
E &= e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right) \\
\mu &= \frac{\partial E}{\partial N} \\
&= \frac{\partial e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)}{\partial N} \\
&= \frac{\partial e^{\frac{2S}{3Nk}-1}}{\partial N}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right) + e^{\frac{2S}{3Nk}-1}\frac{\partial\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right)}{\partial N} \\
&= -\frac{2S}{3N^2k}e^{\frac{2S}{3Nk}-1}\left(\frac{3Nh^2}{4\pi mV^{\frac{2}{3}}}\right) + e^{\frac{2S}{3Nk}-1}\left(\frac{3h^2}{4\pi mV^{\frac{2}{3}}}\right) \\
&= -\frac{2S}{3Nk}e^{\frac{2S}{3Nk}-1}\left(\frac{3h^2}{4\pi mV^{\frac{2}{3}}}\right) + e^{\frac{2S}{3Nk}-1}\left(\frac{3h^2}{4\pi mV^{\frac{2}{3}}}\right) \\
&= e^{\frac{2S}{3Nk}-1}\left(\frac{3h^2}{4\pi mV^{\frac{2}{3}}}\right)\left(1 - \frac{2S}{3Nk}\right).
\end{aligned}
$$

Y con esto podemos probar si

$$
\begin{aligned}
\mu\left(\lambda N, \lambda V, \lambda S\right) = \lambda\mu\left(N, V, S\right) \\
&= e^{\frac{2\lambda S}{3\lambda Nk}-1}\left(\frac{3h^2}{4\pi m\lambda^{\frac{2}{3}}V^{\frac{2}{3}}}\right)\left(1 - \frac{2\lambda S}{3\lambda Nk}\right) \\
&= e^{\frac{2S}{3Nk}-1}\left(\frac{3h^2}{4\pi m\lambda^{\frac{2}{3}}V^{\frac{2}{3}}}\right)\left(1 - \frac{2S}{3Nk}\right)
\end{aligned}
$$

Que como se ve no se coincide con una cantidad intensiva.

1.6

1.7

Chapter 2

Chapter 3

3.1

3.2

3.3

Chapter 4

4.1

4.2

4.3

4.4

4.5

Chapter 5

5.1

5.2

5.3

Chapter 6

6.1

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