SIGNATURE ____________________ NAME ______________________

Student ID # ____________________

Physics 404
Spring 2011
Prof. Anlage
Second Mid-Term Exam
21 April, 2011
CLOSED BOOK, NO Calculator Permitted, CRIB SHEET ALLOWED
Point totals are given for each part of the question.

If you run out of room, continue writing on the back of the same page. If you do so, make a note on the front part of the page!

Note: You must solve the problem following the instructions given in the problem. Correct answers alone will not receive full credit.

Partial Credit:

→ Show Your Work! Answers written with no explanation will not receive full credit.

→ You can receive credit for describing the method you would use to solve a problem, even if you missed an earlier part.

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Problem	Credit	Max. Credit
1		25
2		25
3		25
4		25
TOTAL		100

$\int_{-\infty}^{+\infty} \exp(-x^2)dx = \pi^{1/2}$ $\int_{-\infty}^{+\infty} x^2\exp(-x^2)dx = \frac{\pi^{1/2}}{2}$ $n! \cong (2\pi n)^{1/2} n^n \exp\left[-n + \frac{1}{12n}\right]$ $\frac{1}{1-x} = \sum_{n=0}^{\infty} x^n$

$F = -\tau\log(Z) = U - \tau\sigma$ $dU(\sigma,V) = \tau d\sigma - PdV + \mu dN$ $dF(\tau,V) = -\sigma d\tau - PdV + \mu dN$

$Z = \sum_s Exp[-\varepsilon_s/\tau]$ $\frac{1}{\tau} = \partial\sigma/\partial U|_{V,N}$ $C_V = \frac{\partial U}{\partial \tau}|_V$ $\langle N\rangle = \sum_s f(\varepsilon_s)$

$d(XY) = X\,dY + Y\,dX$ $\log(AB) = \log(A) + \log(B)$ $\log(A+B) \neq \log(A) + \log(B)$

$g(N,s) = \frac{N!}{\left(\frac{N}{2}+s\right)!\left(\frac{N}{2}-s\right)!} \cong \sqrt{\frac{2}{\pi N}}\, 2^N e^{-2s^2/N}$ $g(s) = \sum_s g_1(s_1)g_2(s-s_1)$ $P(\varepsilon_s) = \text{Exp}\left(-\frac{\varepsilon_s}{\tau}\right)/Z$

$\langle X\rangle = \sum_s X(s)P(s)$ $p = -\left(\frac{\partial U}{\partial V}\right)|_\sigma = \tau\left(\frac{\partial \sigma}{\partial V}\right)|_U = -\left(\frac{\partial F}{\partial V}\right)|_\tau$ $Z_N = \left(n_Q V\right)^N/N!$

$n_Q = (M\tau/2\pi\hbar^2)^{3/2}$ $pV = N\tau$ $U = \frac{3}{2}N\tau$ $\sigma = N\left[log\left(\frac{n_Q}{n}\right) + \frac{5}{2}\right]$

$Z_{\text{classical}, d=1} = \frac{1}{h}\iint e^{\left(\frac{-H(p,q)}{\tau}\right)} dp\,dq$ $\mathcal{Z} = \sum_N e^{\left(\frac{N\mu}{\tau}\right)} \sum_s e^{\left(\frac{-\varepsilon_s(N)}{\tau}\right)}$ $\int \log(x)dx = x\log(x) - x$