PHYSICS 2A – AUTUMN 1999

QUIZ 4

Your solutions are DUE on TUESDAY, NOVEMBER 23, at the beginning of lecture, in the box outside 201 E. Bridge. Late quizzes will not be accepted, except in very special circumstances.

The Quiz is closed book, but you are allowed one page of personal notes. Calculators are allowed. Symbolic manipulators other than your brain are not allowed. Please justify your answers and show all work.

THE TIME LIMIT IS ONE HOUR.

IMPORTANT: PLEASE WRITE YOUR SECTION NUMBER AND YOUR T.A.’s NAME, AS WELL AS YOUR OWN, ON THE FRONT OF YOUR SOLUTION SHEET.

There is a QUIZ REVIEW Sunday 11/21, 7:00 PM, 269 Lauritsen.
Problem 1

Let us define a new quantity called Enthalpy, $H$, as

$$H \equiv U + PV$$

[1 pt] a) Find the relationships for $T$, $V$, and $\mu$ in terms of partial derivatives of $H$.

For parts b and c, assume the number of particles, $N$, is constant.

[1 pt] b) Show that $C_p = (\frac{\partial H}{\partial T})_{P,N}$. Hint: Recall the definition $C_p \equiv T(\frac{\partial S}{\partial T})_{P,N}$

[2 pt] c) Calculate the Enthalpy at temperature $T_p$ of the photon gas using the information given in problem 10.7 which gave us

$$C_v = aVT^3$$

Assume $\gamma = \frac{4}{3}$ and set the Enthalpy equal to zero at $T = 0$. 
Problem 2

Consider the idealised Otto Cycle below

1→2 adiabatic compression
2→3 heat absorption at constant volume
3→4 adiabatic expansion
4→1 heat rejection at constant volume

All steps are assumed reversible and the gas ideal. The gas has $\gamma = 5/3$.

[1 pt] a) Write down expressions for $Q_H$ and $Q_L$ in terms of $T_1$, $T_2$, $T_3$, $T_4$, and constants.

[1 pt] b) Show that $\eta = 1 - (T_4 - T_1)/(T_3 - T_2)$.

[2 pt] c) Write $\eta$ in terms of the two volumes $V_1$ and $V_2$, and constants.

[2 pt] d) What is the total change as you move in the closed path from 1→2→3→4→1 of the following quantities for the enclosed gas in the piston?

$\Delta P = \ ?$  $\Delta V = \ ?$  $\Delta T = \ ?$  $\Delta S = \ ?$

You do not need to calculate anything explicitly in this part. Use physical reasoning to arrive at your answers.