

Physics 6B Last Exam

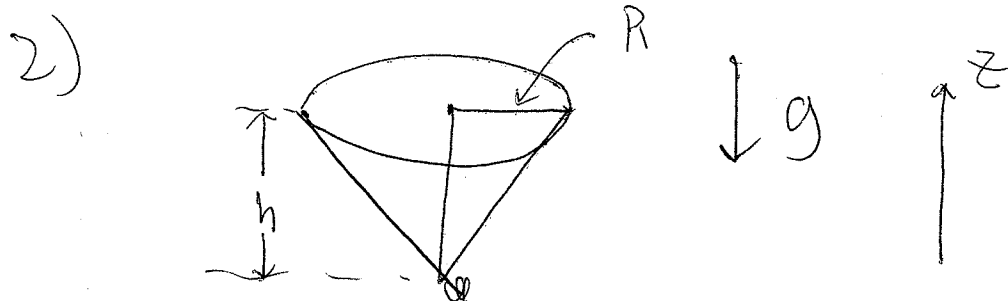
Due: In class, Thursday, March 11, 2 P M
(Problems #1 and #2)

In Toner's office, 12 noon, Saturday, March 20
(@ 1 hour after Vernal Equinox!)
(Problem #3)

Problem 1) Consider a system of 2 particles contained in a box of volume V . The particles ~~are identical~~ are distinguishable; each has the same mass m , and they interact with a potential that is $-\epsilon_0$ if the separation between the particles is $< a$, and 0 if their separation is $> a$. In the microcanonical ensemble, calculate $T(E)$ and $P(V, E)$ for this system, ~~without~~ assuming that $a^3 \ll V$.

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1) cont) How does the pressure behave at large positive energies, and at negative energies? Give a simple physical interpretation of your result in both of these limits.



N identical ^{point} particles of mass m sit in a ^{vertical} cone of radius R and height h , ~~with the~~ with the point down, as shown.

The cone is capped at the top so that none of the particles can escape. Gravity g acts in the negative z direction.

~~Calculate~~

The whole system is in equilibrium with its surroundings at a fixed temperature T .

a) Calculate the partition function, ~~or free~~

2) cont) system. What is the behavior of the specific heat at low temperature? At high temperature? How high must the temperature be for the high temperature limit to hold accurately?

b) Calculate the mean number density $\rho(z)$ inside the cone.

c) Calculate the pressure P_{top} at the top of the cone by considering $\left(\frac{\partial E}{\partial h}\right)_{N, T, P_{\text{top}}}$

$\left(\frac{\partial F}{\partial h}\right)_{T, V}$ holding the shape of the cone (i.e., $\frac{R}{h}$) fixed.

d) What is $\frac{P_{\text{top}}}{\rho(z=h)}$? How could you have guessed this answer?