

Physics 831 Practice Quiz #3, Wednesday, Dec. 6

YOUR NAME: \_\_\_\_\_

1. Consider the Van der Waals equation of state,

$$P = \frac{NT}{V - Nv_0} - a \left( \frac{N}{V} \right)^2.$$

Which terms affect the second virial coefficient?

- (a)  $v_0$
  - (b)  $a$
  - (c) neither  $v_0$  nor  $a$
  - (d) both  $v_0$  and  $a$
2. At the critical point in the liquid-gas phase transition denote each quantity as being zero/finite/infinite.
- (a)  $dP/dV|_T =$  (zero / finite value / infinite value)
  - (b)  $d^2P/dV^2|_T =$  (zero / finite value / infinite value)
  - (c) speed of sound = (zero / finite value / infinite value)
  - (d) the correlation length  $\xi =$  (zero / finite value / infinite value)
3. A diatomic molecule has mass  $m$  and moment of inertia  $I$ . A dilute gas of such molecules is kept at temperature  $T$  and chemical potential  $\mu$ . Assume the temperature is low enough to ignore any vibrational states. For the following questions, do not assume the temperature is so high that rotational states can be treated as a continuum or so low that the excited states can be ignored. In terms of  $\mu$ ,  $\beta = 1/T$ ,  $m$  and  $I$ ,
- (a) Calculate the density  $\rho$ .
  - (b) Calculate the pressure  $P$ .
  - (c) Calculate the energy density  $E/V$ .
  - (d) Calculate the entropy density  $S/V$ .