

Physics 317

Homework #2 – *Due in class, Wed Sep 21*

1. Consider Dieterici's expression for pressure $P(T, V) = \frac{RT}{V-b} e^{-a/RTV}$. Find the critical volume and temperature by solving the equations, $\frac{\partial P}{\partial V} = 0 = \frac{\partial^2 P}{\partial V^2}$
2. A hypothetical substance has volumetric thermal expansion coefficient $\beta = bT/v$ and compressibility $\kappa = a/(Pv)$. Find a formula for its equation of state. *Hint: you'll have to include an unknown constant of integration.*
3. (review, poorly worded GRE Q) A 100 W electric heating element is placed in a pan containing 500 ml of water. Although the element is on for a long time, the water, though close to boiling does not boil. When the heating element is removed, approximately how long will it take for the water to cool by 1 degree? *They don't say it explicitly, but you can assume the system is in steady state when the heating element is "on."*
4. Heat Q is added to a monatomic ideal gas in an isochoric, i.e. constant volume, process, resulting in a temp change of ΔT . How much heat would be required to produce the same temp change in an isobaric process? *Hint: use the difference between the two different specific heat capacities.*
5. Baierlein p21, #2
6. Baierlein p22, #5
7. Baierlein p23, #8
8. Suppose a thermoacoustic system heats by 1 mK. Compute the pressure jump induced, assuming stress confinement (isochoric) and soft tissue values for thermal expansion coefficient $\beta = 3.6 \times 10^{-4} \text{ 1/K}$ and compressibility $\kappa = 4.5 \times 10^{-10} \text{ 1/Pa}$
9. Prepwork
 - a. Have you completed Math 234 yet? Or are you taking it now?
 - b. Have you had modern physics yet?