Physics 201 Sample Exam Three

May 3, 2018

1. A 110 Ω resistor, a 1.257μH inductor and a 0.0543 nF capacitor are connected in series to an AC power supply. The voltage of the power supply is 3.21 V, the frequency is 2.75×10^7Hz, find the current through the loop. Find the voltage across each element.

Equations for problem one: $X_C = \frac{1}{\omega C}$, $X_L = \omega L$, $X_R = R$, $V = XI$, $Z = \sqrt{R^2 + (X_L - X_C)^2}$, and $V = ZI$.

2. Two states have energies of: state A: 2 kcal/mol and for state B: -0.5 kcal/mol. At 300K, what is the probability of each?

3.a. 3.3×10^{22} particles of ideal gas are placed inside a cube, each side is 10 cm long. If they exhert one atmosphere of pressure on the side walls, what must the temperature be? (1 atm = 1.013 x10^5 Pa).

3.b. Now, the temperature is raised or lowered to 300 K, without changing either the number of particles, or the size of the cube. Find the new pressure. (You DO NOT have to do part (a) above to get this part right).

4.a. Give an example in which entropy increases

4.b. Under what conditions will the ideal gas law be a good or bad approximation?

4.c. In some cases, we use the Gibb's free energy, G, in place of energy, E. Why?

4.d. Microscopically, what causes pressure? What is each particle doing?

4.e. In an AC circuit, what does an inductor do? In what case might you use one?

5. Find out if $E(x,t) = 5V/m(55x^2 + 321t^2)$ can be a solution to the electromagnetic wave equation. If so, find the wave speed. If not, expain why it is not.

6. We have two states: the energy and entropy of state A are set to zero. The energy of state B is 1.11 kcal/mol less than that of state A, and at T=300K, state B is twice as likely as state A. Find the entropy of state B. Find the temperature at which the two states are equally probably.

7. An object is 44.4 cm behind an ideal, thin lens with a focal length of 12.9 cm. Where does the image form? What is the magnification?

8. A laser with a 555 nm wavelength shines through a 0.123 mm slit and is projected onto a screen 3.45 m away. What is the distance from the center of the central bright spot to the first (closest) dark spot?