University of Mississippi
PHYS 214 Sec 4, 22 Feb 2006

Name: ___________________________

Test 1

Read these instructions:

Answer all of the following questions. You may use a calculator, but no book or notes. You may add more sheets for the problems, if needed. Keep in mind that what you write should be a readable, well-organized and understandable explanation of how you arrive at each answer. Each question and each problem are worth the same number of points.
Questions: Explain all your answers; Do not use more than half a page for each question.
Problems: For each equation you use, explain why it applies, and in the calculations explain your assumptions; Don't include non-relevant equations and calculations.

Some numbers that may be useful:

— Universal gas constant: $R = 8.314$ J/mol·K
— Boltzmann's constant: $k = 1.38 \times 10^{-23}$ J/K
— Specific heat of ice: $c_{ice} = 0.50$ kcal/kg·ºC = 2100 J/kg·ºC
— Specific heat of water: $c_{water} = 1.00$ kcal/kg·ºC = 4186 J/kg·ºC
— Latent heat of fusion of ice: $L_{ice} = 79.7$ kcal/kg = 333 kJ/kg.

Questions:

1. If you walk outside on a cold, dark, windy night wearing only shorts and a T-shirt, you will soon feel very cold. List the three ways in which heat can be transferred between two places, and for each one explain in what way it contributes to making you feel cold.

2. A bottle that was kept in the freezer and is full of ice is placed in a room at normal room temperature. The second law of thermodynamics can be applied to this situation. Write down two of the statements of the second law, and using one of those statements as an example, explain how it applies to what happens to the ice in the bottle.

3. A proton is accelerated by the potential difference V between two metal plates a distance d apart. It leaves one plate at rest and reaches the other plate with a speed v.

With what speed would the proton reach the other plate if the distance d was doubled?
(a) v. (b) $v/2$. (c) $2v$. (d) $0.71v$. (e) $1.41v$. (f) It wouldn't get there.

With what speed would the proton reach the other plate if the voltage V was doubled?
(a) v. (b) $v/2$. (c) $2v$. (d) $0.71v$. (e) $1.41v$. (f) It wouldn't get there.

With what speed would a deuterium nucleus reach the other plate? (Same charge, twice the mass.)
(a) v. (b) $v/2$. (c) $2v$. (d) $0.71v$. (e) $1.41v$. (f) It wouldn't get there.

With what speed would an electron reach the other plate?
(a) v. (b) $v/2$. (c) $2v$. (d) $0.71v$. (e) $1.41v$. (f) It wouldn't get there.

Problems:

4. A bottle initially filled with 1.00 L of water that had been kept in the freezer and contains ice at 0.0ºC is placed in a room at 22.0ºC (assume that the bottle did not break while in the freezer). By how much will the total entropy of the bottle and the room change between the moment the bottle is placed in the room and right after all the ice has melted?

5. Four charges are placed at the vertices of a square of 20.0 cm side length. The ones on the left are each –8.00 mC, and the ones on the right are each +8.00 mC. What is the electric field at the center of the square, and what force would an electron feel if placed there?

6. Four charges are placed at the vertices of a square of 20.0 cm side length. The ones on the left are each –8.00 mC, and the ones on the right are each +8.00 mC. What is the electric potential at the center of the square, and what electric potential energy would an electron have if placed there? (As usual in these situations, use as reference point at which $V = 0$ one that is very far away, at infinity.)