Physics 2A Final (300 Points MAX)
Spring 2005

Show your work with diagrams, explanations, and clear writings. No credit will be given for answers without diagrams, explanations, and clear writings.

1. (a) A 500-g piece of copper melts at 1083^{o}C. Determine its change in entropy in the process.

   (b) A 20-kg sample of pure water at 40.0^{o}C is mixed with a 20-kg sample of pure water at 32.0^{o}C. Using the average temperatures of each sample, determine the approximate net change in entropy of the total quantity of water.

2. (a) When water is vaporized, it expands and does work in the process. What percent of the heat of vaporization at 100^{o}C is expended on expanding the liquid water into vapor? The density of steam at atmospheric pressure is 0.598 kg/m^{3}.

   (b) A heat engine operating between 200^{o}C and 100^{o}C has an efficiency that is only 20.0% of what is ideally possible. What's its efficiency?

3. (a) What thickness of brick, with a thermal conductivity of 0.60 W/m·K, will conduct heat at the same rate as a 10-cm layer of dead air under the same conditions?

   (b) Roughly how much thermal energy is needed to melt a 3.00-kg block of silver originally at 950.8^{o}C? Where does most of that energy go?

4. (a) A quantity of aluminum shot (c = 910 J/kg·K) at 473 K is mixed with 4.95 kg of water at room temperature, and in a little while, the whole thing comes to equilibrium at 300 K. How much aluminum was used?

   (b) If 1.40 moles of ammonia gas are to be put into a 10.0-liter container at a pressure of 202.6 kPa, at what temperature should the gas be maintained?

5. How much heat must be added to a 1.0-kg mass of water ice at -10^{o}C and atmospheric pressure, in order to transform it into superheated steam at 110^{o}C? Compare the energy associated with each stage of the process.

6. (a) A large, aluminumized-Mylar^{TM} balloon contains 1.000 m^{3} of helium when filled outdoors at 0^{o}C on a winter's day. What will its volume be at home at 20^{o}C?

   (b) A 100-liter storage tank is slowly being filled with gas. At 5.00 times atmospheric pressure, the tank holds 0.60 kg of gas. If the temperature is kept constant, how much gas will be in the tank when the pressure is raised to 10.00 atm?

7. (a) A man running toward the stage in a theater hears an A_4 note from a stationary tuning fork to have a frequency of 441 Hz instead of its more normal 440 Hz. About how fast is he going?

   (b) By international agreement, most orchestras tune to a frequency of 440 Hz, which is called A440 (the A note above middle C). Given that the speed of sound in air at room temperature is 343.9 m/s, what is the wavelength of A440?

8. (a) Taking the Earth to be a uniform sphere of radius 6.37 x 10^{6} m and mass 5.98 x 10^{24} kg, compute its angular momentum about its spin axis.

   (b) A hollow cylinder, or hoop, of mass *m* rolls down an inclined plane from a height *h*. If it begins at rest, show that its final speed is given by $v = \sqrt{gh}$.