Name________________________

Physics 123 Quiz #3, October 25, 2006

1. Wikipedia defines a **Kegerator** as a home made beer dispensing device. A keg, typically of beer, is stored in a refrigerated container in order to keep the keg chilled. The user is able to maintain a tapped keg in such a device for extended periods of time, usually a couple of months, without losing any quality in the taste of the beer. Normally they are made from a refrigerator or a freezer with special equipment. The term "Kegerator" is a portmanteau combining the words keg and refrigerator. Suppose that you want to keep your favorite beer cold inside at a temperature of T_c = 4.4^{o}C and that your kegerator has a coefficient of performance of *16*, what is the temperature of the room? (2 points)

$$K = \frac{T_C}{T_H - T_C} \rightarrow \frac{1}{K} = \frac{T_H - T_C}{T_C} \rightarrow \frac{1}{16} = \frac{T_H - 277.4K}{277.4K} \rightarrow T_H = 294.7K = 21.7^oC$$

2. Imagine we have a pond full of water at 20^{o}C and a 1kg stone, initially at 95^{o}C, is thrown into the pond. What is the entropy change of the water if stone has a specific heat, $c_{granite} = 760\ J/kgK$? (2 points)

$$\Delta S_{water} = \frac{\Delta Q_{water}}{T_{water}} = -\frac{\Delta Q_{rock}}{T_{water}} = -\frac{\left(m_{rock} c_{rock} \Delta T_{rock}\right)}{T_{water}} = -\frac{\left(1kg \times 760 \frac{J}{kgK} \times (20-95)K\right)}{293K} = 194.5 \frac{J}{K}$$

3. Imagine you design a power plant (a sophisticated heat engine) to exploit the temperature difference between the ocean's surface (at 30^{o}C) and floor (at 4^{o}C). How much waste energy would you have to dump into the cold ocean water if your plant produces 1000 MW of power? (6 points)

$$\varepsilon = 1 - \frac{T_C}{T_H} = 1 - \frac{277K}{303K} = 0.086 = \frac{W_{done}/\Delta t}{E_{input}/\Delta t} = \frac{W_{done}/\Delta t}{P_{input}}$$

$$P_{input} = \frac{W_{done}/\Delta t}{\varepsilon} = \frac{1000MW}{0.086} = 1.2 \times 10^{10} W = 12{,}000MW$$

$$P_{output} = P_{input} - \left(W_{done}/\Delta t\right) = 12000MW - 1000MW = 11000MW$$