

Homework #4
Name _____

Due: October 4, 2006
Chemistry 331

1. A hiker caught in a rainstorm absorbs 1 liter of water in his/her clothing. It is windy so that this volume is quickly evaporated at 20°C (the heat of vaporization of water is 2447 kJ/kg at this temperature).

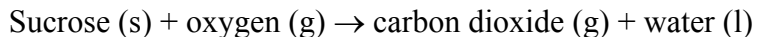
a. If the hiker is the “system” calculate q , the heat transferred. (3 points)

$q =$ _____.

b. If all this heat were removed from the hiker what drop in body temperature would the hiker experience (ignore the metabolism of the hiker)? The hiker weighs 60 kg and has a heat capacity equal to that of water. (3 points)

Decrease in body temperature = _____.

c. How many grams of sucrose would the hiker have to metabolize (quickly) to replace the heat of evaporating one liter of water to maintain his/her original body temperature? You can use the heat of reaction at 25°C; the reaction is:



(4 points)

Grams of sucrose needed to maintain temperature = _____.

2. a. An engineer is designing a solar heating unit for a house. A bed of granite rocks with a surface area of 10 m^2 and volume 10 m^3 will be heated by direct sunlight. The specific heat of the rocks is $4 \text{ Jg}^{-1}\text{K}^{-1}$ and the average density is 4000 kg/m^3 . Assume that the effective radiant power of the sun is 0.1 kW/m^2 and that there are two hours of effective heating per day. Assuming a morning temperature of 298 K , perfect heat transfer, and no losses, what final temperature will be achieved by the rocks at the end of the day? (3 points)

Final temperature = _____.

- b. Assuming perfect heat exchange between the rocks and pumped air, what volume of air ($C_p = 29.0 \text{ Jmol}^{-1}\text{K}^{-1}$) can be heated by 10 K ? (2 points)

Volume of air that can be heated = _____.

3. a. How much solar energy is required to heat 1 mole of circulation water from 300 to 310 K ? (2 points)

Energy required = _____.

- b. A flow of air at 275 K enters a heat exchanger at 22.5 L/sec . The hot water (310 K) supplied from a flat plate solar panel enters the inner tubing of the heat exchanger at 0.018 L/sec . Assuming that the heat exchanger has no losses and that the water and air reach equilibrium as they exit calculate the temperature of the heated air. (3 points)

Temperature of heated air = _____.