This print-out should have 6 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Please notice that for your homework to be considered towards your grade, it needs to be submitted one hour before the corresponding recitation starts. Work submitted after this time, but before the DUE DATE on top of this page, will be accepted but not graded.

PLEASE REMEMBER THAT YOU MUST CARRY OUT YOUR CALCULATIONS TO AT LEAST THREE SIGNIFICANT FIGURES. YOUR ANSWER MUST BE WITHIN ONE PERCENT OF THE CORRECT RESULT TO BE MARKED AS CORRECT BY THE SERVER.

Coastal Air Temperature

20:04, trigonometry, numeric, > 1 min, normal.

001

Given: The specific heat of air is approximately 1 kJ/kg $\cdot^\circ$ C. Take the density of air to 1.25 kg/m^3. The specific heat of water is 4.19 kJ/kg $\cdot^\circ$ C and the density of water is 1000 kg/m^3.

The air temperature above the coastal areas is profoundly influenced by the large specific heat of water.

One reason is that the heat released when 1 m^3 of water cools by 1 °C will raise the temperature of an enormously larger volume of air by 1°C.

Calculate this volume of air. Answer in units of m^3.

Evaporating Nitrogen

20:08, trigonometry, numeric, > 1 min, normal.

002

The specific heat of a metal (similar to copper) is 0.092 cal/g $\cdot^\circ$ C. The latent heat of vaporization of a liquid (similar to liquid nitrogen) is 48 cal/g. A 1 kg block of the metal at 20° C is dropped into a large vessel of the liquid at 77 K which is the boiling point of the liquid.

How many kilograms of the liquid boil away by the time the metal reaches 77 K? Answer in units of kg.

Energy of Sun

20:13, trigonometry, numeric, > 1 min, normal.

003

The surface of the Sun has a temperature of about 5800 K.

Taking the radius of the Sun to be 6.96×10^8 m, calculate the total energy radiated by the Sun each day. Assume $e = 1$ and take $\sigma = 5.6696 \times 10^{-8}$ W/m$^2 \cdot$ K^4. Answer in units of J.

Heat Flow in Brick Wall

20:13, trigonometry, numeric, > 1 min, normal.

004

The brick wall $k = 0.8$ W/m $\cdot^\circ$ C of a building has dimensions of 4 m by 10 m and is 15 cm thick.

How much heat flows through the wall in a 12 h period when the average inside and outside temperatures are, respectively, 20°C and 5°C? Answer in units of MJ.

Heat Loss Through Glass

20:13, trigonometry, numeric, > 1 min, normal.

005

A Thermopane window of area 6 m^2 is constructed of two layers of glass, each 4 mm thick separated by an air space of 5 mm.

If the inside is at 20°C and the outside is at −30°C, what is the heat loss through the window? $k_{\text{glass}} = 0.8$ W/m $\cdot^\circ$ C and $k_{\text{air}} = 0.0234$ W/m $\cdot^\circ$ C . Answer in units of kW.

Heat Transfer

20:13, trigonometry, numeric, > 1 min, normal.

006

A pipe 0.0125 m in diameter and 0.3 m long can transfer 3600 J of heat per second with a temperature difference across the ends of 10°C.

Compare this performance with the heat

transfer of a solid silver bar of the same dimensions by finding the ratio of the given heat to that of the silver bar. Thermal conductivity of silver is 427 $\mathrm{W/m} \cdot {}^{\circ}\mathrm{C}$? (Silver is the best heat conductor of all metals.)