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

001 10.0 points
Given: The specific heat of air is approximately 1 kJ/kg·°C. Take the density of air to 1.25 kg/m³. The specific heat of water is 4.19 kJ/kg·°C and the density of water is 1000 kg/m³.

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 4 m³ of water cools by 3°C will raise the temperature of an enormously larger volume of air by 2°C.

Calculate this volume of air. Answer in units of m³.

002 10.0 points
The specific heat of a metal (similar to copper) is 0.092 cal/g·°C. The latent heat of vaporization of a liquid (similar to liquid nitrogen) is 48 cal/g. A 3 kg block of the metal at 31°C is dropped into a large vessel of the liquid at 74 K which is the boiling point of the liquid.

How many kilograms of the liquid boil away by the time the metal reaches 74 K? Answer in units of kg.

003 10.0 points
The surface of the Sun has a temperature of about 5919 K.

Taking the radius of the Sun to be 6.96 × 10⁸ m, calculate the total energy radiated by the Sun each day. Assume ε = 1 and take σ = 5.6696 × 10⁻⁸ W/m²·K⁴. Answer in units of J.

004 10.0 points
A pipe 0.0216 m in diameter and 0.36 m long can transfer 3710 J of heat per second with a temperature difference across the ends of 12°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 W/m·°C? (Silver is the best heat conductor of all metals.)

005 10.0 points
The brick wall k = 0.76 W/m·°C of a building has dimensions of 6.2 m by 11 m and is 10 cm thick.

How much heat flows through the wall in a 8 h period when the average inside and outside temperatures are, respectively, 28°C and 5°C? Answer in units of MJ.

006 10.0 points
A Thermopane window of area 9.5 m² is constructed of two layers of glass, each 3.2 mm thick separated by an air space of 5 mm.

If the inside is at 11°C and the outside is at −38°C, what is the heat loss through the window? k_glass = 0.8 W/m·°C and k_air = 0.0234 W/m·°C. Answer in units of kW.