

USPAS Cryogenic Engineering (June 21 – July 2, 2021)

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Homework Problems for Tuesday June 30, 2021

1. 2 kW/m^2 pass through a heated wall. The surface of the wall is covered with He II at 1.8 K. Assuming only Kapitza Conductance, what is surface temperature of the wall? (take $\alpha = 0.045$ and $n = 3$)
2. Consider a cylindrical tube of He II at 1 atm. The tube is 12 cm long and is 0.25 cm in diameter. One end of the tube is attached to an infinite heat sink kept at a temperature of 1.8 K. The other end of the tube is held at 2 K. Assuming Mutual Friction Heat transfer, how much heat is transferred through the tube? How much heat would be transferred between these temperatures in a piece of copper with the same length and diameter. Assume the thermal conductivity of the copper is constant and equals 20 W/m K
3. List 3 rules of thumb or best practices to consider when designing cryogenic instrumentation systems
4. Is a Platinum Resistor appropriate for measuring the temperature of a He II Bath? Why or Why Not?
5. Consider a 1 meter long tube that is 5 mm ID connecting a 4.2 K bath and a 300 K sensor. The tube is sealed at the 300 K end. Assume that the midpoint between the 4.2 K temperature and the 300 K temperature occurs at the 0.5 meter point on the tube wall. Are thermoacoustic oscillations likely to occur in this tube?
6. What two aspects make Oxygen Deficiency Hazards particularly dangerous?
7. You are responsible for a small test facility for studying low temperature material properties. The lab includes one LHe test dewar filled from 500 liter portable liquid helium dewars. Describe some of the key ODH considerations for this room.