

Sample Examination

*A journey of a thousand miles begins with a single step – Chinese Proverb*

Warm-ups (5 points, 1 minute each)

1. Express the heat conduction coefficient in fundamental dimensions.
2. Energy is ...
3. The Fourier Law of one dimensional heat conduction is:
4. Express heat transfer by radiation in equation form.
6. A certain material has a k coefficient that can be expressed as  $k = 0.6(T) + 50$  where T is in degrees Kelvin. Calculate the average k for a temperature range from 100C to 300C.

Derivation (20 points, 5 minutes)

7. Derive the one dimensional differential equation governing heat conduction from the conservation of energy equation (assume steady state and no heat generation).

Problems (25 points, 15 minutes each)

8. Consider a large plane wall of thickness  $L = 20$  cm,  $k = 10$  W/m C and a surface area  $A = 10$  m<sup>2</sup>. The left side of the wall is subjected to a net heat flux of 1000 W/m<sup>2</sup> while the temperature at that surface is measured at 100 C. a) Obtain the relation for variation of temperature in the wall and b) evaluate the temperature of the right surface of the wall in C.
9. A 10 mm diameter and 20 cm long aluminum rod ( $k = 237$  W/m C) is attached to a wall at 300 C. The rod is subject to natural convection (air,  $h = 20$  W/m<sup>2</sup> K,  $T_{\infty} = 20$  C. a) Determine the heat transfer from the rod to the surrounding air in W and b) temperature of the rod half way from the wall in C.