1. **[easy]** A laboratory furnace wall is constructed of 0.2 m thick fireclay brick having $k_a=1.0$ W/m·K. This is covered on the outer surface with a 0.03 m thick layer of insulating material having $k_b=0.07$ W/m·K. The furnace inner brick surface is at 1250 K and the outer surface of the insulation material is at 310 K. Calculate the steady state heat transfer rate through the wall in W/m², and determine the interfacial temperature $T_2$ between the brick and the insulation.

2. **[intermediate]** A very long, 1 cm diameter copper rod ($k=377$ W/m·K) is exposed to an environment at 22°C. The base temperature of the rod is maintained at 150°C. The heat transfer coefficient between the rod and the surrounding air is 11 W/m²·K. Determine the heat transfer rate from the rod to the surrounding air.

3. **[difficult]** A 2.5 cm o.d. tube is fitted with 5.0 cm o.d. annular fins spaced on 0.50 cm centers. The fins are aluminum alloy ($k=161$ W/m·K) are of constant thickness 0.0229 cm. The external free convective heat transfer coefficient to the ambient air is 8.5 W/m²·K. For a tube wall temperature of 165°C and an ambient temperature of 27°C, determine the heat loss per meter of length of finned tube.

4. **[intermediate]** Determine the time required for a 1.25 cm diameter carbon steel (1% C) ($k=40$ W/m·K, density: 7800 kg/m³, heat capacitance: 473 W·s/kg·K) sphere to cool from $T_1=500$°C to 100°C if exposed to a cooling air flow at $T_\infty=25$°C resulting in $h=110$ W/m²·K.