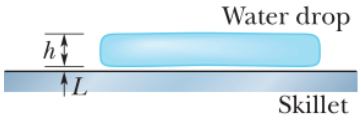
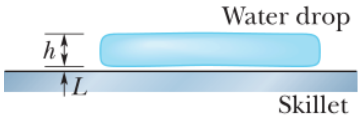
Physics 9B Fall 2013 - Discussion #4

1. An 85.0 N backpack is hung from the middle of an aluminum wire, with linear expansion coefficient $\alpha = 23 \times 10^{-6}$ K^{-1}. The temperature of the wire then drops by 20.0°C. Find the tension in the wire at the lower temperature, assuming that the distance between supports does not change, and ignore thermal stress.
2. A 3.00 g lead bullet at 30.0°C is fired at a speed of 240 m/s into a large block of ice at 0°C, in which it becomes embedded. What quantity of ice melts, if the specific heat of lead is $c_{Pb} = 128$ J/kg·K and the latent heat of fusion for water is $L_w = 3.35 \times 10^5$ J/kg?
3. *Leidenfrost Effect*: Water droplets last about 1 s on a hot skillet between 100°C and 200°C, but can last much longer on a hotter skillet, due to a thin layer of vapor that partially insulates the underside of the droplet. Let $L = 0.100$ mm, and assume the drop is flat with height $h = 1.50$ mm and bottom face area $A = 4 \times 10^{-6}$ m^2. Assume the temperature of the skillet is 300°C, the drop is 100°C, and the vapor has conductivity $k = 0.026$ W/m·K. (a) At what rate is energy conducted from the skillet to the drop? (b) Assuming only conduction, how long will the drop last?



Physics 9B Fall 2013 - Discussion #4

1. An 85.0 N backpack is hung from the middle of an aluminum wire, with linear expansion coefficient $\alpha = 23 \times 10^{-6}$ K^{-1}. The temperature of the wire then drops by 20.0°C. Find the tension in the wire at the lower temperature, assuming that the distance between supports does not change, and ignore thermal stress.
2. A 3.00 g lead bullet at 30.0°C is fired at a speed of 240 m/s into a large block of ice at 0°C, in which it becomes embedded. What quantity of ice melts, if the specific heat of lead is $c_{Pb} = 128$ J/kg·K and the latent heat of fusion for water is $L_w = 3.35 \times 10^5$ J/kg?
3. *Leidenfrost Effect*: Water droplets last about 1 s on a hot skillet between 100°C and 200°C, but can last much longer on a hotter skillet, due to a thin layer of vapor that partially insulates the underside of the droplet. Let $L = 0.100$ mm, and assume the drop is flat with height $h = 1.50$ mm and bottom face area $A = 4 \times 10^{-6}$ m^2. Assume the temperature of the skillet is 300°C, the drop is 100°C, and the vapor has conductivity $k = 0.026$ W/m·K. (a) At what rate is energy conducted from the skillet to the drop? (b) Assuming only conduction, how long will the drop last?



Physics 9B Fall 2013 - Discussion #4

1. An 85.0 N backpack is hung from the middle of an aluminum wire, with linear expansion coefficient $\alpha = 23 \times 10^{-6}$ K^{-1}. The temperature of the wire then drops by 20.0°C. Find the tension in the wire at the lower temperature, assuming that the distance between supports does not change, and ignore thermal stress.
2. A 3.00 g lead bullet at 30.0°C is fired at a speed of 240 m/s into a large block of ice at 0°C, in which it becomes embedded. What quantity of ice melts, if the specific heat of lead is $c_{Pb} = 128$ J/kg·K and the latent heat of fusion for water is $L_w = 3.35 \times 10^5$ J/kg?
3. *Leidenfrost Effect*: Water droplets last about 1 s on a hot skillet between 100°C and 200°C, but can last much longer on a hotter skillet, due to a thin layer of vapor that partially insulates the underside of the droplet. Let $L = 0.100$ mm, and assume the drop is flat with height $h = 1.50$ mm and bottom face area $A = 4 \times 10^{-6}$ m^2. Assume the temperature of the skillet is 300°C, the drop is 100°C, and the vapor has conductivity $k = 0.026$ W/m·K. (a) At what rate is energy conducted from the skillet to the drop? (b) Assuming only conduction, how long will the drop last?