

Physics 1

Problem set 5: Heat Capacity and Heat Transfer

1. During a bout with the flu an 80 – kg man ran a fever of 2.0 degrees C above normal (his body temp was 39 degrees C). Assuming that the human body is mostly water, how much heat is required to raise his temperature by that amount (specific heat capacity of water is 4190 J/kgC).
2. A significant mechanism for heat loss in very cold weather is energy expended in warming the air taken into the lungs with each breath. Assume that the specific heat capacity of air is 1020 J/kgC, and that 1.0 L of air has a mass of 0.0013 kg. On an arctic winter day when the temp is -30 degrees C, calculate the amount of heat needed to warm to body temperature (37 degrees C) the 0.5 L of air exchanged with each breath. How much heat is lost per hour if the respiration rate is 12 breaths/minute?
3. While jogging the average 65-kg student generates heat at a rate of 300 W (or 1080 kJ in that hour). If the heat is not disposed of (by perspiration or other mechanisms) but remains in the student's body, how much would the body temperature rise after jogging for an hour? As in the previous problem, assume the student's specific heat capacity is 4190 J/kgC.

4. What effect does water's specific heat capacity have on planet earth given that the surface is mostly water? What effect does it have on earth's varying temperature?

5. Human's are made of approximately 75% water. In what way is that significant for human life? Why is that important?

6. Why can firewalkers walk barefoot on red-hot wooden coals but not on red-hot pieces of iron (use conduction as a way to explain your answer)?

7. If you stick a metal rod in a snow bank, your hand will soon become cold. Explain this process. Is cold moving into your hand?