

AOS 100/101  
Spring 2018

HOMEWORK #2  
Solutions

1)

Since both kinds of seats have been sitting in the same environment for a prolonged period of time, they would have identical, or nearly identical, temperatures. It would be more comfortable to sit on the wooden bleacher seat than the metal one because wood, being a poor conductor of heat, would not act to remove heat as quickly from your body as would the metal seat.

2)

Since Object A's temperature is increasing, it must be absorbing more radiation than it is emitting – as any object will experience a temperature rise only under such conditions. Knowing that Object A emits 100 units of radiative energy, it has to be the case that Object B emits more than 100 units, let's say 120 units. If Object B is emitting 120 units of radiative energy but is only absorbing 100 (as it only absorbs what is emitted from A), the Object B will experience a temperature decrease.

3)

The Stefan-Boltzmann Law tells us that if Object B is emitting more radiation than A, then it must have a higher temperature than A (at least initially). As B radiates more energy than it absorbs, its temperature decreases. As A absorbs more energy than it emits, its temperature increases. Thus, we have a situation in which the originally warmer Object B gradually cools while the originally colder Object A gradually warms. Such a transfer of heat from the warmer B to the cooler A precisely conforms with the Second Law.

4)

Another way to interpret the statement that "Snow behaves like a black-body with respect to infra-red radiation" is to say that snow is able to absorb and emit infra-red radiation extremely well. If a person inhabits an igloo or a snowcave, the infra-red radiation emitted by that person is readily absorbed by the snow on the inside wall of the igloo or cave. This absorption warms the snow and the snow begins to re-radiate infra-red back into the inside of the igloo. Since humans are able to keep body temperature constant, there is a constant source of infra-red radiation inside the igloo. The snow, with its excellent absorbing and emitting characteristics acts to trap some of the energy that you are radiating inside the igloo, eventually warming it up inside. The longer you stay, the warmer it gets.