

PHYS 1200 Physics of Everyday Experience

Review questions and exercises for Lecture 17 (T-2)

1. What is the distinction between heat and work in terms of molecular motion?
2. What are the advantages of using a thermocouple-based thermometer compared to a mercury thermometer?
3. Strips 1 meter long by 1 cm wide by 1 mm thick are formed in aluminum, rubber, and steel. Compare the lengths of the three strips after their temperatures are raised by the same amount.
4. Why is it easier to unscrew a jar lid when it is placed under a stream of hot water?
5. A bimetal strip is made using aluminum and iron. When heated, how will this bimetal strip bend?
6. What are the three mechanisms of heat flow?
7. Two otherwise identical pans are made from aluminum and iron. When each of these is used for cooking, which pan handle is likely to get too hot to touch more quickly?
8. What role does convection play when water is boiled on a stove?
9. On a cold but sunny day in winter, you are warmed by the sun. By what mechanism does this occur?

Answers:

1. Heat energy involves the random motion of molecules. Work involves organized motion of molecules.
2. A thermocouple thermometer can cover a much larger range of temperatures compared to a mercury thermometer. It can also be used as part of an electronic temperature control system.
3. The coefficients of linear expansions of the three materials are in the order: rubber, aluminum, and steel from highest to lowest. Thus for the same temperature increase, the rubber strip will expand more than the aluminum which will expand more than the steel.
4. When the lid of the jar is placed under hot water, it expands allowing it to be removed more easily.
5. Aluminum expands more when heated than steel, so the bimetal strip will curve toward the side made of steel.
6. Convection, conduction, and radiation
7. The thermal conductivity of aluminum is larger than that of steel, so the handle of the aluminum pan will get hot faster than the steel pan.
8. The heat enters from the bottom but as the water is heated, the hotter water rises and mixes with the cooler water near the top allowing all the water to come to boiling.
9. The warmth you feel on a cold sunny day is due to the radiation of the sun.