

Due Wednesday, April 11, 2006

Questions for grading:

1. (a) "Room temperature" is taken to mean 68 F. What is this on the Celsius scale and on the Kelvin scale?
(b) The freezing point of mercury is -38.9 C. What is this on the Fahrenheit scale and on the Kelvin scale?
(c) The estimated surface temperature of the surface of the sun is 5800 K. What is this on the Celsius scale and on the Fahrenheit scale?
2. The pendulum of a clock consists of an iron rod, about a meter long, with a heavy weight at the end of it. If it is adjusted to tick at the right speed at a temperature 17 C, how much time will it gain or lose during 12 hours during which the average temperature is 27 C?
[In case you have forgotten, the period of a pendulum is $2\pi\sqrt{l/g}$, where l is the length of the pendulum.]
3. (Adapted from Giancoli, Chapter 17, Problem 37) (a) A hot air balloon has a balloon of volume 2500 m^3 , filled with air which is heated by a burner under the opening at the bottom of the balloon. What temperature must the air inside the balloon be to lift a load of 240 kg (balloon fabric, basket, passenger, etc.) off the ground, if the outside air has a temperature of 20 C and a pressure of $1.0 \times 10^5 \text{ Pa}$?
(b) What temperature would be needed to keep the balloon at an altitude where the air pressure is $0.7 \times 10^5 \text{ Pa}$.
4. (a) What is the number of molecules in a liter of gas which has been pumped down to $2 \times 10^{-12} \text{ Pa}$ at a temperature of 20 C?
(b) What would be the number if the temperature were -70 C at the same pressure?

Other questions, for practice, and for discussion:

5. An old style railroad is built from iron rails of length 20 m with gaps between them to allow for thermal expansion. If the rails are designed just to touch one another when they reach a temperature of 50 C, what will be the gaps between them when the temperature goes down to -20 C.
6. (Adapted from Giancoli, Chapter 17, Question 18) Will the buoyant force on a aluminum cylinder submerged in water increase or decrease if the temperature is increased from 20 C to 40 C?
7. One solid aluminum sphere and one hollow aluminum sphere of the same external radius are heated from 20 C to 100 C. Will each continue to displace the same volume of water as the other?