DAY 25

Homework Assignment (see syllabus for homework collection information)

1. A driver inflates his tires to the recommended 32 psi (as read by the tire gauge) when the temperature outside is 25°F. What will the pressure in the tire be in the summer when the temperature is 90°F?

2. A mylar Valentines' Day balloon has a volume of 2 ft^3 when in the balloon store (T = 70°F). What will the volume of the balloon be when Romeo takes it outside into the cold February air (T = 15°F)?

3. Now many molecules are present in a 1 l bottle filled with air at 1 atm pressure at 68°F?

4. Hot air balloons work on a combination of Ideal gas Law and Archimedes' Principle – heating the air in the balloon causes it to expand and become less dense than the surrounding air, and the balloon exerts a lift on the gondola below.

   The hot air balloon shown has a volume of 115,000 ft^3. On a day when the air temperature is 50°F, to what temperature must the air in the balloon be heated if the balloon is to generate 2 tons of lift?

http://www.prairienet.org/bagi/bl-potato.html
http://www.hotairpotato.com/aboutballoon.html

5. Joe puts 3 ice cubes in a 12 oz glass and fills it with tap water. Jane puts 6 cubes in the same size glass and fills it with tap water. Both are sitting in the same back yard and

neither actually drink any of their water. It will take 20 minutes for Joe's ice to completely melt away.

After 5 minutes, whose drink is colder? Whose drink will be colder after 15 minutes? After 25 minutes?

6. A student puts 1.25 liters of water on a 500 W hot plate and brings it to a boil. If the water begins boiling at 5:00 PM, what is the earliest time that the last of the water could completely boil away?

7. How much heat is required to melt a 100 g ice cube? Give answer in J, cal, Cal, and BTU.

8. Two identical masses are removed from a freezer in which they have sat for many hours. One is dropped into a well-insulated cup full of water. The other is dropped into a well-insulated cup containing alcohol. Both water and alcohol are at room temperature.

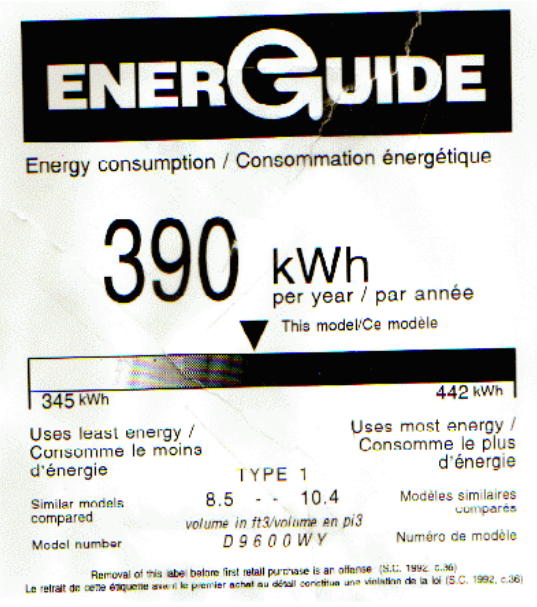
   Which system will be colder when it reaches equilibrium?

9. In the above problem, the freezer has a temperature of $-5^{\circ}C$, room temperature is $20^{\circ}C$, the masses are 500 g copper cylinders, and the cups each contain 500 ml of their respective fluids. Find the temperature each system reaches at equilibrium.

10. A refrigerator is a device that removes heat from warm objects. At right is the sticker from the inside of the refrigerator in the Social Sciences building office suite. Since a refrigerator is always plugged in, this sticker is for continuous operation.

    Assume that only a third of the power consumed by the refrigerator goes into removing heat from inside. If you put a two-liter bottle of water at room temperature ($20^{\circ}C$) into the freezer, and nothing else is in there, how long will it be before the bottle is frozen solid?

    HINT – a kWh is a kilowatt-hour. That's the energy you use when you consume energy at the rate of one kilowatt for a total of one hour.



11. Calculate the amount of heat required to raise the temperature of 1 liter of the following materials by 10°C:

Water
Ice
Alcohol
Silver
Iron
Wood (pine)

12. A 2000 kg car is moving at 20 m/s. The driver hits the brakes and the car comes to a halt. The car has anti-lock brakes so the wheels did not lock up. The brake disks in the car are iron and have a mass of 5 kg each. By how much did the temperature of the brakes go up?

13. In the figure at right the outlet on the pipe is 10 meters below the water level in the tank. The water in the tank has a temperature of 10°C. Water is squirting out the pipe at 8 m/s. What is the temperature of the water?