Chapter 17 and 18 Tutorial

Thermodynamics I, II, III & IV

Chapter 17 : Temperature and Heat

Chapter 18: Thermal Properties of Matter

Chapter 19: The First Law of Thermodynamics

Chapter 20: The Second Law of Thermodynamics

Question 1:

You place a small piece of ice in your mouth. Eventually, the water all converts from ice at $T_1 = 32.00°F$ to body temperature $T_2 = 98.60°F$. Express these temperatures in both Celsius degrees and kelvins, and find difference of temperature = $T_2 - T_1$ in both cases.

Question 2:

The pressure of a gas at the triple point of water is 1.35 atm. If its volume remains unchanged, what will its pressure be at the temperature at which CO_2 solidifies?

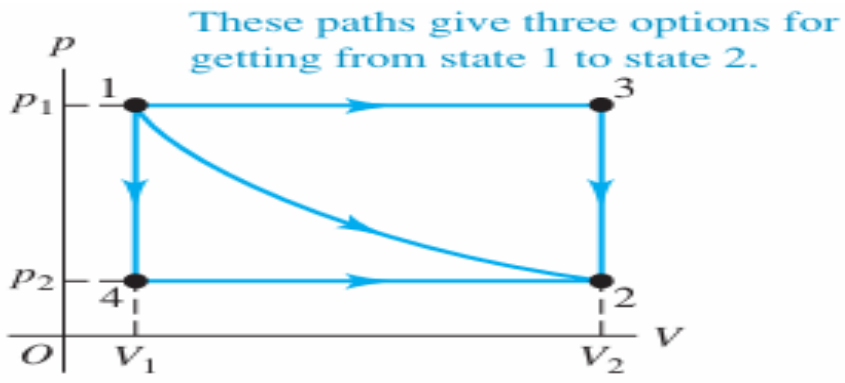
Question 3:

If the air temperature is the same as the temperature of your skin (about 30°C), your body cannot get rid of heat by transferring it to the air. In that case, it gets rid of the heat by evaporating water (sweat). During bicycling, a typical 70-kg person's body produces energy at a rate of about 500 W due to metabolism, 80% of which is converted to heat.

(a) How many kilograms of water must the person's body evaporate in an hour to get rid of this heat? The heat of vaporization of water at body temperature is 2.42×10^6 J/kg.
(b) The evaporated water must, of course, be replenished, or the person will dehydrate. How many 750-mL bottles of water must the bicyclist drink per hour to replenish the lost water? (Recall that the mass of a liter of water is 1.0 kg.

Question 4:

(a) In figure shown below consider the closed loop 1→3→2→4→1. This is a cyclic process in which the initial and final states are the same. Find the total work done by the system in this cyclic process, and show that it is equal to the area enclosed by the loop.
(b) How is the work done for the process in part (a) related to the work done if the loop is traversed in the opposite direction, 1→4→2→3→1? Explain.



Question 5:
The engine of a Ferrari F355 F1 sports car takes in air at 20.0ºC and 1.00 atm and compresses it adiabatically to 0.0900 times the original volume. The air may be treated as an ideal gas with γ =1.40.

(a) Draw a pV-diagram for this process.
(b) Find the final temperature and pressure.

Question 6:

A gasoline engine has a power output of 180 kW (about 241 hp). Its thermal efficiency is 28.0%.

(a) How much heat must be supplied to the engine per second?
(b) How much heat is discarded by the engine per second?

Question 7:

During the time 0.305 mol of an ideal gas under goes an isothermal compression at 22.0°C, 468 J of work is done on it by the surroundings.

(a) If the final pressure is 1.76 atm, what was the initial pressure?
(b) Sketch a pV-diagram for the process.

Question 8:

A sophomore with nothing better to do adds heat to 0.350 kg of ice at 0.0°C until it is all melted.

(a) What is the change in entropy of the water?
(b) The source of heat is a very massive body at a temperature of 25.0°C. What is the change in entropy of this body?
(c) What is the total change in entropy of the water and the heat source?

Question 9:

One kilogram of water at 0ºC is heated to 100°C. Compute its change in entropy. Assume that the specific heat of water is constant at 4190 J/kg.K over this temperature range.

Question 10:

Define following terms;

(a) State variables
(b) Equation of state
(c) Write down few examples of state variables

Question 11:

You have two identical containers, one containing gas A and the other containing gas B. The masses of these molecules are $m_A=3.34\times10^{-27}$kg and $m_B=5.34\times10^{-26}$ kg. Both gases are under the same pressure and are at 10.0°C.

(a) Which molecules (A or B) have greater translational kinetic energy per molecule and rms speeds?
(b) If we raise the temperature of only one of these containers so that both gases will have the same rms speed. For which gas should you raise the temperature?
(c) At what temperature will you accomplish your goal?
(d) Once you have accomplished your goal, which molecules (A or B) now have greater average translational kinetic energy per molecule?