7th Assignment, due Wednesday **November 25th** (class, no later than NOON) - distributed November 13th

Please note your name clearly on your solutions, number the pages and write notes along the way, so that it is easy to follow your thought process.
No pencil!

1.) Explain in your own words: (6 points)
a) What does Entropy mean?
b) The first law of thermodynamics.
c) Why pipelines (for example for oil) often include loops.
d) The difference between heat, temperature and internal energy.

2.) A drag racer, starting from rest, speeds up for 402 m with an acceleration of $+17.0\ m/s^2$. A parachute then opens, slowing the car down with an acceleration of $-6.10\ m/s^2$. How fast is the racer moving 3.50×10^2 m after the parachute opens? (2 points)

3.) Heat Q flows spontaneously from a reservoir at 395 K into a reservoir that has a lower temperature T. Because of the spontaneous flow, thirty percent of Q is rendered unavailable for work when a Carnot engine operates between the reservoir at temperature T and reservoir at 248 K. Find the temperature T. (2 points)

4.) A cowboy fires a silver bullet with a muzzle speed of 200 m/s into a pine wall of a saloon. Assume all the internal energy generated by the impact remains with the bullet. (The specific heat for silver is 234 J/(kg C).
(a) What is the temperature change of the bullet? (2 points)
(b) Will the temperature change of the bullet be larger or smaller, if the bullet is made out of lead (specific heat 128 J(kg C))? (1 point)

5.) A cylinder contains 3.00 mol of helium gas at a temperature of 300 K.
(a) If the gas is heated at constant volume, how much energy must be transferred by heat to the gas for its temperature to increase to 500 K? (2 points)
(b) How much energy must be transferred by heat to the gas at constant pressure to raise the temperature to 500 K? (2 points)

6.) Two kilograms of liquid water at 0 °C is put into the freezer compartment of a Carnot refrigerator. The temperature of the compartment is -15 °C, and the temperature of the kitchen is 27 °C. If the cost of electrical energy is ten cents per kilowatt hour, how much does it cost to make two kilograms of ice? (2 points)

7.) In exercising, a weight lifter loses 0.150 kg of water through evaporation, the heat required to evaporate the water coming from the weight lifters body. The work done in lifting weights is 1.40×10^5 J.

(a) Assuming that the latent heat of vaporization of perspiration os 2.42×10^6 J/kg, find the change in the internal energy of the weight lifter. (2 points)

(b) Determine the minimum number of nutritional Calories of food (1 nutritional Calorie = 4186 J) that must be consumed to replace the loss of internal energy. (1 points)

8.) Even at rest, the human body generates heat. That heat arises because of the body's metabolism -- that is, the chemical reactions that are always occurring in the body to generate energy. In rooms designed for use by large groups, adequate ventilation or air conditioning must be provided to remove this heat. Consider a classroom containing 200 students. Assume that the metabolic rate of generating heat is 130 W for each student and that the heat accumulates during a fifty-minute lecture. In addition, assume that the air has a molar specific heat of $C_V = 5/2R$ and that the room (volume = 1200 m^3, initial pressure = 1.01×10^5 Pa, and initial temperature = 21 °C) is sealed shut. If all the heat generated by the students were absorbed by the air, by how much would the air temperature rise during a lecture? (3 points)

9.) Find the change in entropy of the H_2O molecules when (5 points)

(a) three kilograms of ice melts into water at 273 K and

(b) three kilograms of water changes into steam at 373 K.

(c) On the basis of the answers, discuss which change create more disorder in the collection of H_2O molecules.