Problem 2.1

A nonconducting container filled with 25 kg of water at 20 deg C is fitted with a stirrer which is made to turn by gravity acting on a weight of mass 35 kg. The weight falls slowly through a distance of 5 m in driving the stirrer. Assuming that all work done on the weight is transferred to the water and that the local acceleration of gravity is 9.8 $\frac{m}{s^2}$, determine:

(a) The amount of work done on the water.

(b) The internal energy change of the water.

(c) The final temperature of the water, for which Cp=4.18 $\frac{\text{kJ}}{\text{kg*degC}}$.

(d) The amount of heat that must be removed from the water to return it to its initial temperature.

(e) The total energy change of the universe because of (1) the process of lowering the weight, (2) the process of cooling the water back to its initial temperature, and (3) both processes together.

Problem 2.4

An electric motor under steady load draws 9.7 amperes at 110 volts, delivering 1.25 hp of mechanical energy. What is the rate of heat transfer from the motor, in kW?

Problem 2.9

Heat in the amount of 7.5 kJ is added to a closed system while its internal energy decreases by 12 kJ. How much energy is transferred as work? For a process causing the same change of state but for which the work is zero, how much heat is transferred?

Problem 2.11

An incompressible fluid (ρ = constant) is contained in an insulated cylinder fitted with a frictionless piston. Can energy as work be transferred to the fluid? What is the change in internal energy of the fluid when the pressure is increased from P1 to P2?

Problem 2.13

An electric motor runs “hot” under load, owing to internal irreversibilities. It has been suggested that the associated energy loss can be minimized by thermally insulating the motor casing. Comment critically on this suggestion.