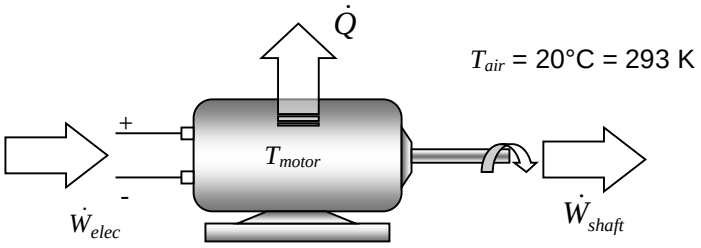
Example

An electric motor operating at steady state draws a current of 10 amps with a voltage of 220 volts. The power factor is one. The output shaft rotates at 1000 RPM (= 104.7 rad/s) with a torque of 16 N-m applied to the external load. The rate of heat transfer from the motor to its surroundings is by convection. The convection heat transfer coefficient, h_{conv}, is 100 W/(m^2-K) and the surface area of the motor is A = 0.195 m^2.

(a) Determine the surface temperature of the motor T_{motor} in K.
(b) Taking just the motor as the system, calculate the rate of entropy generation in kW/K.
(c) If the system is enlarged to include enough of the surroundings such that the system boundary temperature is T_{air}, calculate the rate of entropy production. What happened?
(d) Consider the case where the rate of heat transfer goes to zero and the shaft power equals the input electrical power. What is the rate of entropy production now?



Example

An electric current of 5 amps passes through a 15 Ω resistor causing it to reach a steady temperature of 30°C.

(a) Calculate the rate of entropy generation in W/K.
(b) An engineering student at some unnamed lesser institution where there is no ConApps course suggests that the reverse process can be used to generate electricity. (E.g., lighting a fire underneath the resistor will cause current to flow through the resistor.) Use you superior ConApps skills to prove that the process is impossible.