6.32 An iron block of unknown mass at 85°C is dropped into an insulated tank that contains 100L of water at 20°C. At the same time, a paddle wheel driven by a 200-W motor is activated to stir the water. It is observed that thermal equilibrium is established after 20min. with a final temperature of 24°C. Determine the mass of the iron block and the entropy generation during this process.

6.33 A hollow steel sphere with a 0.5m inside diameter and a 2mm thick wall contains water at 2MPa, 250°C. The system (steel plus water) cools to the ambient temperature, 30°C. Calculate the net entropy change of the system and surroundings for this process.

6.34 A large slab of concrete, 5x8x0.3m, is used as a thermal storage mass in a solar-heated house. If the slab cools overnight 23°C to 18°C house, what is the net entropy change associated with this process?

6.35 A foundry form box with 25kg of 200°C hot sand is dumped into a bucket with 50L water at 15°C. assuming no heat transfer with the surroundings and no boiling away of liquid water, calculate the net entropy change for the process.

6.36 Oxygen gas is compressed in a piston-cylinder device from an initial state of 0.8m^3/kg and 25°C to a final state of 0.1m^3/kg and 287°C. Determine the entropy change of the oxygen during this process, assuming (a) constant specific heat and (b) variable specific heats.

6.37 0.07m^3 of air at a pressure of 0.9MPa and temperature of 20°C expands to eight times its original volume and the final temperature after expansion is 50°C. Calculate change of entropy of air during the process.

6.38 Calculate the change of entropy of 3kg of air when it is heated at constant volume from 100kPa to 500kPa.

6.39 A 0.14m^3 insulated rigid tank contains 2.6kg of carbon dioxide at 100kPa. Now paddle wheel work is done on the system until the pressure in the tank rises to 120kPa. Determine (a) paddle-wheel work done during this process and (b) the entropy change for this process.

6.40 An insulated piston-cylinder initially contains 400L of air at 140kPa, 27°C. Air is now heated for 15min by a 250-W resistance heater placed inside the cylinder. The pressure of air is maintained constant during this process. Determine the entropy change of air, assuming (a) constant specific heats (b) variable specific heats.

6.41 A mass of 1kg of air contained in a cylinder at 1.5MPa, 1000K, expands in a reversible isothermal process to a volume 10 times larger. Calculate the heat transfer during the process and the change of entropy of the air.

6.42 A mass of 1kg of air contained in a cylinder at 1.5MPa, 1000K, expands in a reversible adiabatic process to 100kPa. Calculate the final temperature and the work done during the process, using (a)the constant specific heat, (b)the ideal gas tables

6.43 A rigid tank contains 2kg of air at 200kPa and ambient temperature, 20°C. An electric current now passes through a resistor inside the tank. After a total of 100kJ of electrical work has crossed the boundary, the air temperature inside is 80°C. is this possible.

6.44 A rigid storage tank of 1.5m^3 contains 1kg argon at 30°C. Heat is then transferred to the argon from a furnace operating at 300°C until the specific entropy of the argon has increased by 0.343kJ/kgK, Find the total heat transfer and the entropy generated in the process.

6.45 A 1m^3 insulated, rigid tank contains air at 1000kPa, 25°C. A valve on the tank is opened, and the pressure inside quickly drops to 200kPa, at which point the valve is closed. Assuming that the air remaining inside has undergone a reversible adiabatic expansion, calculate the mass withdrawn during the process.

6.46 A rigid container with volume 200L is divided into two equal volumes by a partition. Both sides contain nitrogen, one side is at 2MPa, 200°C, and the other at 200kPa, 100°C. The partition ruptures, and the nitrogen comes to a uniform state at 70°C. Assume the temperature of the surroundings is 20°C, determine the work done and the net entropy change for the process.

6.47 Nitrogen at 600kPa, 127°C is in a 0.5m^3 insulated tank connected to a pipe with a valve to a second insulated initially empty tank of volume 0.5m^3 . the valve is opened and the nitrogen fills both tanks. Find the final pressure and temperature and the entropy generation this process causes. Why is the process irreversible?

6.48 A cylinder-piston contains carbon dioxide at 1MPa, 300°C with a volume of 200L. The total external force acting on the piston is proportional to $V^{3.1}$. This system is allowed to cool to room temperature, 20°C. What is the total entropy generation for the process.

6.49 A cylinder-piston contains 1kg of air at 100kPa, 20°C. the gas is compressed reversibly to a pressure of 800kPa. Calculate the work required if the process is (a)Adiabatic (b)Isothermal (c)Polytropic, with exponent n=1.15

6.50 Helium in a piston-cylinder at 25°C, 100kPa is brought to 400K in a reversible polytropic process with exponent n=1.25. You may assume helium is an ideal gas with constant specific heat. Find the final pressure and both the specific heat transfer and specific work.

6.51 A 0.3kg of air at 350kPa and 35°C receives heat at constant volume until its pressure becomes 700kPa. It then receives heat at constant pressure until its volume becomes 0.2289m^3. Determine the change of entropy during each process.

6.52 A quantity of gas has a pressure of 700kPa and it occupies a volume of 0.014m^3 at a temperature of 150°C. The gas expanded isothermally to a volume of 0.084m^3. Determine the change of entropy.

6.53 A quantity of air has an initial pressure, volume and temperature of 130kPa, 0.224m^3 and 21°C, respectively. It is compressed to a volume of 0.028m^3 according to the law $PV^{1.3}$=const. Determine the change of entropy and state whether it is an increase or decrease.

6.54 Show that a gas has its state changed according to the law PV^n=constant,, then , the change of specific entropy is given by the expression

$$\Delta s = Cv(k-n)\ln\frac{v_2}{v_1}$$

where Cv=specific heat at constant volume, k= adiabatic index
n=polytropic index, v_1=initial volume, v_2= final volume

6.55 0.5kg of air is expanded according to the law $PV^{1.2}$=constant, from initial conditions 1.4MPa and 0.06m^3 to a final pressure of 0.35MPa. Determine the heat transferred by the air during the expansion.