Problem 5.2

A Carnot engine receives 250 kJ s-1 of heat from a heat source reservoir at 525 deg C and rejects heat to a heat-sink reservoir at 50 deg C. What are the power developed and the heat rejected?

Problem 5.6

Which is the more effective way to increase the thermal efficiency of a Carnot engine: to increase T_H with T_C constant, or to decrease T_C with T_H constant? For a real engine, which would be the more practical way?

Problem 5.8

With respect to 1 kg of liquid water:

(a) Initially at 0 deg C, it is heated to 100 deg C by contact with a heat reservoir at 100 deg C. What is the entropy change of the water? What is the entropy change of the heat reservoir? What is ΔS_{total}?

(b) Initially at 0 deg C, it is first heated to 50 deg C by contact with a heat reservoir at 50 deg C, and then heated to 100 deg C by contact with a heat reservoir at 100 deg C. What is ΔS_{total}?

(c) Explain how the water might be heated from 0 deg C to 100 deg C so that $\Delta S_{total} = 0$.

Problem 5.10

An ideal gas, Cp = (7/2)R, is heated in a steady-flow heat exchanger from 70 deg C to 190 deg C by another stream of the same gas, which enters at 320 deg C. The flow rates of the two streams are the same, and heat losses from the exchanger are negligible.

(a) Calculate the molar entropy changes of the two gas streams for both parallel and countercurrent flow in the exchanger.

(b) What is ΔS_{total} in each case?

(c) Repeat parts (a) and (b) for countercurrent flow if the heating stream enters at 200 deg C.

Problem Set 8 – 1-page answer key

5.2 Power developed: W=-148.782 kJ/sec //ANS
Heat rejected: Q_c=-101.218 kJ/sec //ANS

5.6 Use partial derivatives to show that lowering the temperature of the cold reservoir will always be more effective at increasing η than raising the temperature of the hot reservoir. All mathematics must be fully explained. Graphical solutions are not general. More practical way: raise the temperature of the hot reservoir with explanation.

5.8

	ΔS_{cold}	ΔS_{hot}	ΔS_{total}
	kJ/K	kJ/K	kJ/K
Part (a)			
Step 1	1.305 //ANS	-1.121 //ANS	0.184 //ANS
Part (b)			
Step 1	0.703	-0.644	---
Step 2	0.602	-0.561	0.097 //ANS
Part (c)	Infinite steps; answer should be passed on (a) and (b) //ANS		

5.10

	ΔS_{cold}	ΔS_{hot}	ΔS_{total} (part b)
	J/(mol·K)	J/(mol·K)	J/(mol·K)
Part (a)	8.726 //ANS	-6.577 //ANS	
Part (b)			2.149 //ANS
Part (c)	8.726 //ANS	-8.512 //ANS	0.214 //ANS
Countercurrent and parallel flow are the same with explanation. //ANS			