Chapter 20 Tutorial

Thermodynamics-IV

Chapter 20 : The Second Law of Thermodynamics

Question 1:

A room air conditioner has a coefficient of performance of 2.9 on a hot day and uses 850 W of electrical power.

(a) How many joules of heat does the air conditioner remove from the room in one minute?
(b) How many joules of heat does the air conditioner deliver to the hot outside air in one minute?
(c) Explain why your answers to parts (a) and (b) are not the same.

Question 2:

An aircraft engine takes in 9000 J of heat and discards 6400 J each cycle.

(a) What is the mechanical work output of the engine during one cycle?
(b) What is the thermal efficiency of the engine?

Question 3:

The Otto-cycle engine in a Mercedes-Benz SLK230 has a compression ratio of 8.8.

(a) What is the ideal efficiency of the engine? Use Y = 1.40.
(b) The engine in a Dodge Viper GT2 has a slightly higher compression ratio of 9.6. How much increase in the ideal efficiency results from this increase in the compression ratio

Question4:
You design an engine that takes in 1.50×10^4 J of heat at 650 K in each cycle and rejects heat at a temperature of 350 K. The engine completes 240 cycles in 1 minute. What is the theoretical maximum power output of your engine, in horsepower?

Question 5:

You decide to take a nice hot bath but discover that your thoughtless roommate has used up most of the hot water. You fill the tub with 270 kg of 30.0°C water and attempt to warm it further by pouring in 5.00 kg of boiling water from the stove.

(a) Is this a reversible or an irreversible process? Use physical reasoning to explain.
(b) Calculate the final temperature of the bath water.
(c) Calculate the net change in entropy of the system (bath water + boiling water), assuming no heat exchange with, the air or the tub itself.

Question 6:

Three moles of an ideal gas undergo a reversible isothermal compression at 20.0°C. During this compression, 1850 J of work is done on the gas. What is the change of entropy of the gas?