PRACTICE C

Heat-Engine Efficiency

1. If a steam engine takes in 2.254×10^4 kJ from the boiler and gives up 1.915×10^4 kJ in exhaust during one cycle, what is the engine's efficiency?
2. A test model for an experimental gasoline engine does 45 J of work in one cycle and gives up 31 J as heat. What is the engine's efficiency?
3. A steam engine absorbs 1.98×10^5 J and expels 1.49×10^5 J in each cycle. Assume that all of the remaining energy is used to do work.
   a. What is the engine's efficiency?
   b. How much work is done in each cycle?
4. If a gasoline engine has an efficiency of 21 percent and loses 780 J to the cooling system and exhaust during each cycle, how much work is done by the engine?
5. A certain diesel engine performs 372 J of work in each cycle with an efficiency of 33.0 percent. How much energy is transferred from the engine to the exhaust and cooling system as heat?
6. If the energy removed from an engine as heat during one cycle is 6.0×10^2 J, how much energy must be added to the engine during one cycle in order for it to operate at 31 percent efficiency?

ENTROPY

When you shuffle a deck of cards, it is highly improbable that the cards would end up separated by suit and in numerical sequence. Such a highly ordered arrangement can be formed in only a few ways, but there are more than 8×10^{67} ways to arrange 52 cards (because $52! = 8 \times 10^{67}$).

In thermodynamics, a system left to itself tends to go from a state with a very ordered set of energies (one that has only a small probability of being randomly formed) to one in which there is less order (or that has a high probability of being randomly formed). The measure of a system's disorder is called the **entropy** of the system. The greater the entropy of a system is, the greater the system's disorder.

entropy

a measure of the randomness or disorder of a system

The greater probability of a disordered arrangement indicates that an ordered system is likely to become disordered. Put another way, the entropy of a system tends to increase. This greater probability also reduces the chance that a disordered system will become ordered at random. Thus, once a system has reached a state of greatest disorder, it will tend to remain in that state and have *maximum entropy.*