

## Answers to selected questions

### Chapter 11

**Q6.** The first law of thermodynamics dictates that the work output of the engine equals the net heat input. Energy is conserved and work and heat are just different modes of energy transfer.

**Q12.** No. There are many irreversible processes taking place in an automobile engine including the explosive burning of the gasoline-air mixture.

**Q18.** No. The coils on the back of the refrigerator release more heat to the room than that removed from the inside of the refrigerator so leaving the door open will actually cause the room to get warmer.

**Q24.** Yes. The process of allowing the coffee to cool by heat flowing to the surroundings is irreversible producing no useful work. The entropy of the universe increases in any irreversible process.

**Q30.** Heat obtained from a flat-plate solar collector is best used for space heating (or water heating) because it is low-grade heat having too low a temperature to efficiently run a heat engine.