* 15–11 Statistical Interpretation

* **45.** (II) Calculate the probabilities, when you throw two dice, of obtaining (*a*) a 5, and (*b*) an 11.

* **46.** (II) Rank the following five-card hands in order of increasing probability: (*a*) four aces and a king; (*b*) six of hearts, eight of diamonds, queen of clubs, three of hearts, jack of spades; (*c*) two jacks, two queens, and an ace; and (*d*) any hand having no two equal-value cards. Discuss your ranking in terms of microstates and macrostates.

* **47.** (II) Suppose that you repeatedly shake six coins in your hand and drop them on the floor. Construct a table showing the number of microstates that correspond to each macrostate. What is the probability of obtaining (*a*) three heads and three tails, and (*b*) six heads?

* 15–12 Energy Resources

* **48.** (I) Solar cells (Fig. 15–26) can produce about 40 W of electricity per square meter of surface area if directly facing the Sun. How large an area is required to supply the needs of a house that requires 22 kWh/day? Would this fit on the roof of an average house? (Assume the Sun shines about 9 h/day.)

FIGURE 15–26 Problem 48.

* **49.** (II) Energy may be stored for use during peak demand by pumping water to a high reservoir when demand is low and then releasing it to drive turbines when needed. Suppose water is pumped to a lake 135 m above the turbines at a rate of 1.00×10^5 kg/s for 10.0 h at night. (*a*) How much energy (kWh) is needed to do this each night? (*b*) If all this energy is released during a 14-h day, at 75% efficiency, what is the average power output?

* **50.** (II) Water is stored in an artificial lake created by a dam (Fig. 15–27). The water depth is 45 m at the dam, and a steady flow rate of 35 m^3/s is maintained through hydroelectric turbines installed near the base of the dam. How much electrical power can be produced?

FIGURE 15–27 Problem 50.

General Problems

51. An inventor claims to have designed and built an engine that produces 1.50 MW of usable work while taking in 3.00 MW of thermal energy at 425 K, and rejecting 1.50 MW of thermal energy at 215 K. Is there anything fishy about his claim? Explain.

52. When 5.30×10^5 J of heat is added to a gas enclosed in a cylinder fitted with a light frictionless piston maintained at atmospheric pressure, the volume is observed to increase from 1.9 m^3 to 4.1 m^3. Calculate (*a*) the work done by the gas, and (*b*) the change in internal energy of the gas. (*c*) Graph this process on a *PV* diagram.

53. A 4-cylinder gasoline engine has an efficiency of 0.25 and delivers 220 J of work per cycle per cylinder. When the engine fires at 45 cycles per second, (*a*) what is the work done per second? (*b*) What is the total heat input per second from the fuel? (*c*) If the energy content of gasoline is 35 MJ per liter, how long does one liter last?

54. A "Carnot" refrigerator (the reverse of a Carnot engine) absorbs heat from the freezer compartment at a temperature of −17°C and exhausts it into the room at 25°C. (*a*) How much work must be done by the refrigerator to change 0.50 kg of water at 25°C into ice at −17°C? (*b*) If the compressor output is 210 W, what minimum time is needed to accomplish this?

55. It has been suggested that a heat engine could be developed that made use of the temperature difference between water at the surface of the ocean and that several hundred meters deep. In the tropics, the temperatures may be 27°C and 4°C, respectively. (*a*) What is the maximum efficiency such an engine could have? (*b*) Why might such an engine be feasible in spite of the low efficiency? (*c*) Can you imagine any adverse environmental effects that might occur?