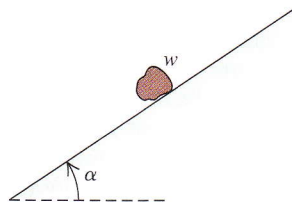


64. ●● A boulder of weight  $w$  rests on a hillside that rises at a constant angle  $\alpha$  above the horizontal, as shown in Figure 1.30. The boulder's weight  $w$  is a force on the boulder that has a direction vertically downward. (a) In terms of  $\alpha$  and  $w$ , what is the component of the weight of the boulder in the direction parallel to the surface of the hill? (b) What is the component of the weight in the direction perpendicular to the surface of the hill? (c) An air-conditioner unit is fastened to a roof that slopes upward at an angle of  $35.0^\circ$ . In order that the unit not slide down the roof, the component of the unit's weight parallel to the roof cannot exceed 550 N. What is the maximum allowed weight of the unit?
65. ●● **Bones and muscles.** A patient in therapy has a forearm that weighs 20.5 N and lifts a 112.0 N weight. The only other significant forces on his forearm come from the biceps muscle



► FIGURE 1.30 Problem 64.

(which acts perpendicularly to the line of the elbow. If the biceps produce a pull on the arm is raised  $43^\circ$  above the horizontal, in the direction of the force that the elbow exerts on the arm the weight of the arm and the weight of the forearm their vector sum must be 132.5 N upward.)

66. ●● **Googols and googolplexes.** When Edward Kasner asked his young nephew Milton what a huge number  $10^{100}$ , the boy said "googol" in standard notation as a 1 followed by 100 zeroes. (b) Approximately how many atoms does our sun contain? For simplicity, assume the sun consists of only protons and electrons, which is approximately true. (Consult Appendix E.) A googolplex is an even larger number,  $10^{\text{googol}}$ . Express the googolplex in standard notation with a 1 followed by a googol zeroes, how many zeroes?