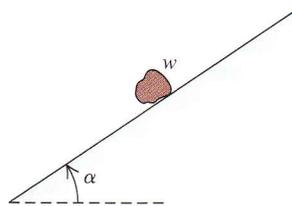


64. ●● A boulder of weight w rests on a hillside that rises at a constant angle α above the horizontal, as shown in Figure 1.30. The boulder's weight w is a force on the boulder that has a direction vertically downward. (a) In terms of α and w , what is the component of the weight of the boulder in the 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° . 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?



► FIGURE 1.30 Problem 64.

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

(which acts perpendicularly to the line of the arm). If the biceps produce a pull on the arm that is raised 43° above the horizontal, in what direction does the elbow force act? (Hint: The elbow force and the biceps force must balance the weight of the arm and the weight of the object. Their vector sum must be 132.5 N upward.)

66. ●● **Googols and googolplexes!** When Edward Kasner asked his young nephew Milton how many zeros a googol has, the boy said a googol is a 1 followed by 100 zeros. (a) Express the number of zeros in a googolplex in standard notation. (b) Approximately how many atoms does our sun contain? For simplicity, assume the sun consists of only protons and neutrons, which is approximately true. (Consult Appendix B for the mass of a proton and a neutron.) A googolplex is an even larger number, 10^{googol} . Express the googolplex in standard notation with a 1 followed by an appropriate number of zeros, how many zeros?

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