

24. (II) An athlete executing a long jump leaves the ground at a  $28.0^\circ$  angle and travels 7.80 m. (a) What was the takeoff speed? (b) If this speed were increased by just 5.0%, how much longer would the jump be?
25. (II) Determine how much farther a person can jump on the Moon as compared to the Earth if the takeoff speed and angle are the same. The acceleration due to gravity on the Moon is one-sixth what it is on Earth.
26. (II) A hunter aims directly at a target (on the same level) 75.0 m away. (a) If the bullet leaves the gun at a speed of 180 m/s, by how much will it miss the target? (b) At what angle should the gun be aimed so as to hit the target?
27. (II) The pilot of an airplane traveling 180 km/h wants to drop supplies to flood victims isolated on a patch of land 160 m below. The supplies should be dropped how many seconds before the plane is directly overhead?
28. (II) Show that the speed with which a projectile leaves the ground is equal to its speed just before it strikes the ground at the end of its journey, assuming the firing level equals the landing level.
29. (II) Suppose the kick in Example 3–5 is attempted 36.0 m from the goalposts, whose crossbar is 3.00 m above the ground. If the football is directed correctly between the goalposts, will it pass over the bar and be a field goal? Show why or why not.
30. (II) A projectile is fired with an initial speed of 65.2 m/s at an angle of  $34.5^\circ$  above the horizontal on a long flat firing range. Determine (a) the maximum height reached by the projectile, (b) the total time in the air, (c) the total horizontal distance covered (that is, the range), and (d) the velocity of the projectile 1.50 s after firing.
31. (II) A projectile is shot from the edge of a cliff 125 m above ground level with an initial speed of 65.0 m/s at an angle of  $37.0^\circ$  with the horizontal, as shown in Fig. 3–35. (a) Determine the time taken by the projectile to hit point P at ground level. (b) Determine the range  $X$  of the projectile as measured from the base of the cliff. At the instant just before the projectile hits point P, find (c) the horizontal and the vertical components of its velocity, (d) the magnitude of the velocity, and (e) the angle made by the velocity vector with the horizontal. (f) Find the maximum height above the cliff top reached by the projectile.

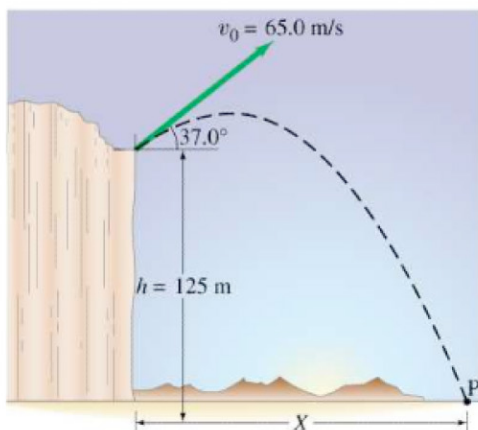


FIGURE 3–35 Problem 31.

32. (II) A shotputter throws the shot with an initial speed of 15.5 m/s at a  $34.0^\circ$  angle to the horizontal. Calculate the horizontal distance traveled by the shot if it leaves the athlete's hand at a height of 2.20 m above the ground.
33. (II) At what projection angle will the range of a projectile equal its maximum height?
34. (III) Revisit Conceptual Example 3–7, and assume that the boy with the slingshot is *below* the boy in the tree (Fig. 3–36), and so aims *upward*, directly at the boy in the tree. Show that again the boy in the tree makes the wrong move by letting go at the moment the water balloon is shot.

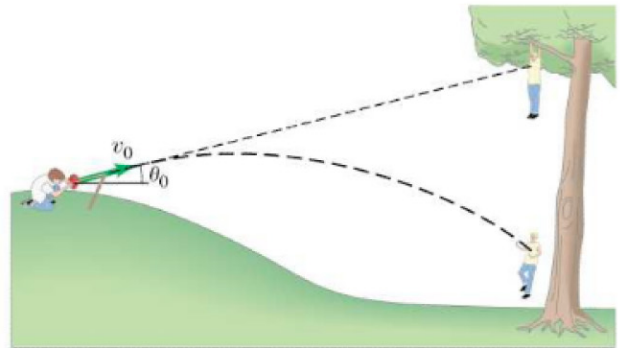


FIGURE 3–36 Problem 34.

35. (III) A rescue plane wants to drop supplies to isolated mountain climbers on a rocky ridge 235 m below. If the plane is traveling horizontally with a speed of 250 km/h (69.4 m/s), (a) how far in advance of the recipients (horizontal distance) must the goods be dropped (Fig. 3–37a)? (b) Suppose, instead, that the plane releases the supplies a horizontal distance of 425 m in advance of the mountain climbers. What vertical velocity (up or down) should the supplies be given so that they arrive precisely at the climbers' position (Fig. 3–37b)? (c) With what speed do the supplies land in the latter case?

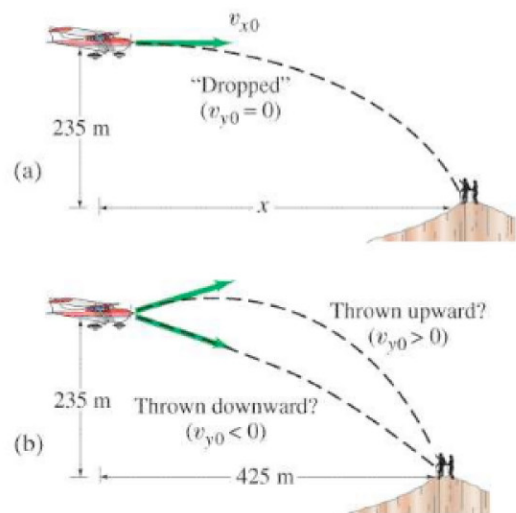


FIGURE 3–37 Problem 35.