

## TWO DIMENSIONAL MOTION

1. A long-jumper leaves the ground at an angle of  $20.0^\circ$  to the horizontal at a speed of 11 m/s. (A) How far does he jump? (B) What was the maximum height he reached? (7.9 m, 0.72 m)
2. A punter kicks a football at an angle of  $30.0^\circ$  with the horizontal at an initial speed of 20.0 m/s. Where should a punt returner position himself to catch the ball just before it strikes the ground? (35.3 m)
3. In an ideal punt, the football has a hang time (total time in the air) of 5.0 s. If a punter kicks the ball at an angle of  $45^\circ$  with the horizontal, what must be the initial velocity of the ball to achieve this? (35 m/s)
4. A daredevil decides to jump a canyon of width 10.0 m. To do so, he drives a motorcycle up a  $15^\circ$  inclined slope. What minimum velocity must he have in order to clear the canyon? (14.0 m/s)
5. A stone is thrown upward from the top of a building at an angle of  $30^\circ$  to the horizontal and with an initial speed of 20.0 m/s. If the height of the building is 45 m,
  - (A) How long is the stone "in flight" before it hits the ground below? (4.22 s)
  - (B) What is the speed of the stone as it strikes the ground?  
( $V_y = 31$  m/s,  $V_R = 36$  m/s)
  - (C) Where does the stone strike the ground? (73 m)
6. A bird flies directly into a wind. If the bird's forward speed relative to the wind is 58.0 km/h and the wind's speed in the opposite direction is 55.0 km/h, relative to Earth, how long will it take the bird to fly 1.4 km? (0.47 h or 28 min)
7. A torpedo fired at an anchored target moves against a current. Suppose the torpedo's velocity with respect to the current is 51 km/h east, and the current's velocity with respect to the target is 4.0 km/h south.
  - (A) If the torpedo hits the target in 14 s, how far away is the target from the point where the torpedo is launched? ( $2.0 \times 10^2$  m)
  - (B) How far north of the target must the torpedo be launched in order to hit the target? (16 m north of the target)
8. A zookeeper finds an escaped monkey hanging from a light pole. Aiming her tranquilizer gun at the monkey, she kneels 10.0 m from the light pole, which is 5.00 m high. The tip of her gun is 1.00 m above the ground. At the same moment that the monkey drops a banana, the zookeeper shoots. If the dart travels at 50.0 m/s, will the dart hit the monkey, the banana, or neither one? Give mathematical proof.