# TWO DIMENSIONAL MOTION

1. A long-jumper leaves the ground at an angle of 20.0° 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° 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° 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° 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° 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)*

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