Practice

Understanding Concepts

8. A field hockey ball is struck and undergoes projectile motion. Air resistance is negligible.
   (a) What is the vertical component of velocity at the top of the flight?
   (b) What is the acceleration at the top of the flight?
   (c) How does the rise time compare to the fall time if the ball lands at the same level from which it was struck?

9. A cannon is set at an angle of 45° above the horizontal. A cannonball leaves the muzzle with a speed of 2.2×10^2 m/s. Air resistance is negligible. Determine the cannonball's
   (a) maximum height
   (b) time of flight
   (c) horizontal range (to the same vertical level)
   (d) velocity at impact

10. A medieval prince trapped in a castle wraps a message around a rock and throws it from the top of the castle wall with an initial velocity of 12 m/s [42° above the horizontal]. The rock lands just on the far side of the castle's moat, at a level 9.5 m below the initial level (**Figure 14**). Determine the rock's
    (a) time of flight
    (b) width of the moat
    (c) velocity at impact

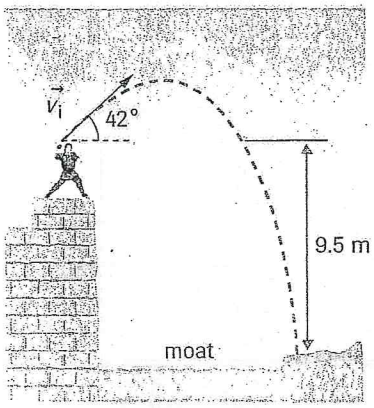

Figure 14
The situation for question 10

Answers

9. (a) 1.2×10^3 m
   (b) 32 s
   (c) 4.9×10^3 m
   (d) 2.2×10^2 m/s [45° below the horizontal]

10. (a) 2.4 s
    (b) 22 m
    (c) 18 m/s [60° below the horizontal]

Section 7.4 Questions

Understanding Concepts

1. What is the vertical acceleration of a projectile on its way up, at the top of its trajectory, and on its way down?

2. (a) For a projectile with the launch point lower than the landing point, in what part of the flight is the magnitude of the velocity at a maximum? a minimum?
   (b) In what part of the flight is the magnitude of the velocity at a maximum, and in what part is it at a minimum, for a projectile with the launch point higher than the landing point?

3. A projectile launched horizontally moves 16 m in the horizontal plane while falling 1.5 m in the vertical plane. Determine the projectile's initial velocity.

4. A tennis player serves a ball horizontally, giving it a speed of 24 m/s from a height of 2.5 m. The player is 12 m from the net. The top of the net is 0.90 m above the court surface. The ball clears the net and lands on the other side. Air resistance is negligible.
   (a) For how long is the ball airborne?
   (b) What is the horizontal displacement?
   (c) What is the velocity at impact?
   (d) By what distance does the ball clear the net?

SUMMARY

- A projectile is an object moving through the air in a curved trajectory with no propulsion system.
- Projectile motion is motion with a constant horizontal velocity combined with a constant vertical acceleration.
- The horizontal and vertical motions of a projectile are independent of each other except they have a common time.
- Projectile motion problems can be solved by applying the constant velocity equation for the horizontal component of the motion and the constant acceleration equations for the vertical component of the motion.