26. In the oscilloscope shown in Figure 6, an electron beam is deflected by an electric force produced by charged metal plates AD and BC. In the region ABCD, each electron experiences a uniform downward electric force of 3.20×10^{-15} N. Each electron enters the electric field along the illustrated axis, halfway between A and B, with a velocity of 2.25×10^{7} m/s

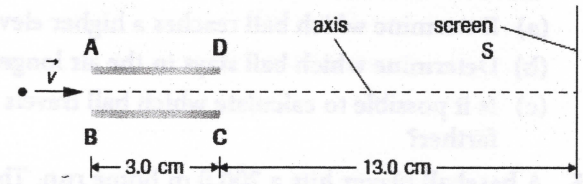

Figure 6

parallel to the plates. The electric force is zero outside ABCD. The mass of an electron is 9.11×10^{-31} kg. The gravitational force can be neglected during the short time interval an electron travels to the fluorescent screen, S. Determine how far an electron is below the axis of entry when it hits the screen.

30. A child throws a snowball with a horizontal velocity of 18 m/s directly toward a tree, from a distance of 9.0 m and a height above the ground of 1.5 m.
    (a) After what time interval does the snowball hit the tree?
    (b) At what height above the ground will the snowball hit the tree?
    (c) Determine the snowball's velocity as it strikes the tree.

31. Determine the initial velocity of a projectile that is launched horizontally, and falls 1.5 m while moving 16 m horizontally.

35. A pole vault jumper clears the crossbar set at a height of 6.0 m above the mat.
    (a) Determine the time interval for the first 45 cm on the way down.
    (b) Determine the time interval for the last 45 cm before reaching the mat.
    (c) Explain why the jumper appears to be in "slow motion" near the top of the jump.

50. In a basketball game, a ball leaves a player's hand 6.1 m downrange from the basket from a height of 1.2 m below the level of the basket. If the initial velocity of the ball is 7.8 m [55° above the horizontal] in line with the basket, will the player score a basket? If not, by how much will the ball miss the basket?

39. Figure 5 shows a demonstration of projectile motion that usually warrants applause from the audience. At the instant a dart is launched at a high velocity, a target (often a cardboard monkey) drops from a uspended position downrange from the launching device. Show that if the dart is aimed directly at the target, it will always strike the falling target. (Use a specific set of numbers.)

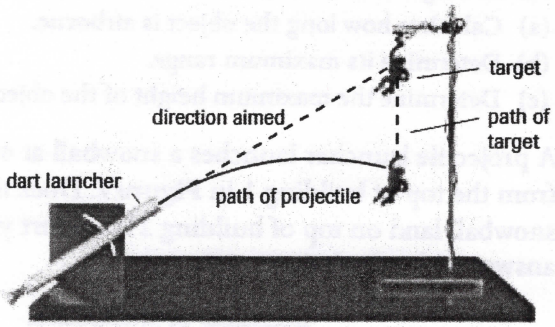

Figure 5
In this "monkey-hunter" demonstration, launching the dart causes the target to drop.

3. In a physics demonstration, a volleyball is tossed from a window at 6.0 m/s [32° below the horizontal], and it lands 3.4 s later. Calculate (a) the height of the window and (b) the velocity of the volleyball at ground level. K/U T/I A

4. A person kicks a soccer ball with an initial velocity directed 53° above the horizontal. The ball lands on a roof 7.2 m high. The wall of the building is 25 m away, and it takes the ball 2.1 s to pass directly over the wall. K/U T/I A
    (a) Calculate the initial velocity of the ball.
    (b) Determine the horizontal range of the ball.
    (c) By what vertical distance does the ball clear the wall of the building?

5. A small asteroid strikes the surface of Mars and causes a rock to fly upward with a velocity of 26 m/s [52° above the horizontal]. The rock rises to a maximum height and then lands on the side of a hill 12 m above its initial position. The acceleration due to gravity on the surface of Mars is 3.7 m/s^2. K/U T/I A
    (a) Calculate the maximum height of the rock.
    (b) Determine the time that the rock is in flight.
    (c) What is the range of the rock?

6. A rock is thrown at an angle of 65° above the horizontal at 16 m/s up a hill that makes an angle of 30° with the horizontal. How far up the hill will the rock go before hitting the ground? K/U T/I A

Questions

1. A rock kicked horizontally off a cliff moves 8.3 m horizontally while falling 1.5 m vertically. Calculate the rock's initial speed. K/U T/I A

2. A projectile launcher sends an object with an initial velocity of 1.1×10^3 m/s [45° above the horizontal] into the air. The launch level is at the same level as the landing level. K/U T/I A
   (a) Calculate how long the object is airborne.
   (b) Determine its maximum range.
   (c) Determine the maximum height of the object.

7. A projectile launcher launches a snowball at 45 m/s from the top of building 1 in **Figure 7**. Does the snowball land on top of building 2? Support your answer with calculations. T/I

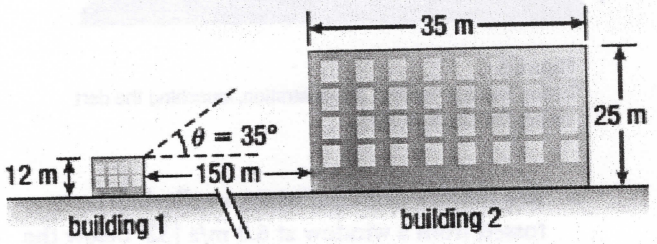

Figure 7

63. A puma can jump to a height of 3.7 m when its initial velocity is at an angle of 45° to the horizontal. Calculate the initial speed of the puma. (1.5) K/U T/I A

64. Two footballs are kicked from the ground with equal initial speeds. Ball A is launched at a greater angle above the horizontal than ball B. (1.5) K/U T/I A
   (a) Determine which ball reaches a higher elevation.
   (b) Determine which ball stays in the air longer.
   (c) Is it possible to calculate which ball travels farther?

65. A baseball player hits a 200.0 m home run. The ball travels at an angle of 45° with the horizontal just after being hit. Determine the initial speed with which the ball left the bat. Assume that air resistance is negligible and that the ball lands at approximately the same height from which it was hit. (1.5) K/U T/I A

66. A basketball player is standing 9.5 m from the basket, which is at a height of 3.1 m. She throws the ball from an initial height of 2.0 m at an angle of 35° above the horizontal. The ball goes straight through the basket. Determine the initial speed of the ball. (1.5) K/U T/I A

67. A batter hits a ball, which flies at an angle of 45° with the horizontal. The ball's speed after being hit by the bat is 30.0 m/s. Calculate the time the ball stays in the air. The ball lands at the same height at which it was hit. Air resistance is negligible. (1.5) K/U T/I A

68. A firefighter aims a hose at an angle of 60.0° with the horizontal. The water comes out of the hose with a speed of 60.0 m/s. (1.5) K/U T/I A
   (a) Calculate the maximum height the water can reach.
   (b) Determine the horizontal distance the water travels from the hose.

69. A dolphin leaps out of the water at an angle of 60.0° above the horizontal. The horizontal component of the dolphin's velocity is 8.0 m/s. Calculate the magnitude of the vertical component of its velocity. (1.5) K/U T/I A

70. A tennis ball is struck such that it leaves the racquet with a horizontal speed of 28.0 m/s. The ball hits the top of the net, and the player loses the point. What could she have done to avoid losing the point? (1.5) K/U T/I A

71. An athlete in a long jump trial leaves the ground at a certain angle and covers a horizontal distance of 8.7 m. The speed with which he can jump remains constant. What should he do to increase the distance of his jump? (1.5) K/U T/I A

82. A javelin thrower argues with her coach that if her throw can keep the javelin in the air for a longer time, it will always travel a greater distance. Is the argument correct? Explain why or why not. (1.5) K/U T/I A

72. In a snowball fight, a person throws one snowball at 26 m/s at an angle of 75° above the horizontal. While the target (his friend) is watching the snowball, he throws another at a smaller angle and the same speed as the first person, and both snowballs hit the friend at the same spot at the same time. Assume that the snowballs land at the same level as the initial throw. (1.5) K/U T/I A
   (a) What is the range of the first snowball?
   (b) At what angle was the second snowball thrown?
   (c) How long was the second snowball thrown after the first?

73. A soccer player kicks the ball in a parabolic path. The ball leaves the player's foot with a speed of 27 m/s, making an angle of 20.0° with the horizontal. (1.5) K/U T/I A
   (a) Calculate the maximum height of its trajectory.
   (b) Determine its speed as it hits the ground again. Air resistance is negligible.

74. In a practice session, a volleyball player hits a ball horizontally with a speed of 27 m/s from a height of 2.4 m. The ball travels until it hits the ground. (1.5) K/U T/I A
   (a) Determine the time the ball is in the air.
   (b) Determine the horizontal distance travelled by the ball.
   (c) Calculate the ball's speed as it hits the ground.

Answers:

Page 1

26. 3.02×10^{-2} m

30. a) 0.50 s
    b) 0.30 m
    c) 19 m/s [15° below horizontal]

31. 29 m/s [horizontal]

35. a) 0.30 s
    b) 0.042 s

50. short by ~~1.1~~ 1.6 m

3. a) 67 m
   b) 37 m/s [82° below horizontal]

4. a) 2.0 x 10 m/s [53° above horizontal]
   b) 32 m
   c) 4.4 m

5. a) 57 m
   b) 1.0 x 10 s
   c) 170 m

6. 17 m

Page 2

1. 15.1 m/s [R]

2. a) 1.6×10^2 s
   b) ~~1.6~~ $\times 10^2$ km 1.2×10^2 km
   c) 31 km

7. dy max = 33.9m , yes dx = 173m @ dy = 13m

63. 12 m/s

65. 44 m/s

66. 11 m/s

67. 4.3 s

68. a) 138 m
    b) 318 m

69. 14 m/s

72. a) 35 m
    b) 15°
    c) 3.8 s

73. a) 4.4 m
    b) 27 m/s

74. a) 0.70 s
    b) 19 m
    c) 28 m/s