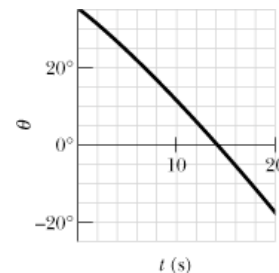
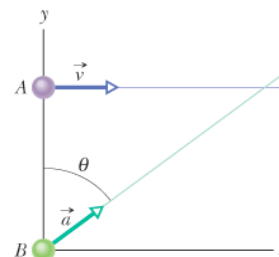


Chapter 4 – Problem Day



10. The position vector $\vec{r} = 5.00t\hat{i} + (et + ft^2)\hat{j}$ locates a particle as a function of time t . Vector \vec{r} is in meters, t is in seconds, and factors e and f are constants. The figure gives the angle θ of the particle's direction of travel as a function of t (θ is measured from the positive x direction). What are (a) e and (b) f , including units?

20. Particle A moves along the line $y = 30\text{ m}$ with a constant velocity \vec{v} of magnitude 3.0 m/s and parallel to the x -axis. At the instant particle A passes the y axis, particle B leaves the origin with zero initial speed and constant acceleration \vec{a} of magnitude 0.40 m/s^2 . What angle θ between \vec{a} and the positive direction of the y -axis would result in a collision?



24. A small ball rolls horizontally off the edge of a tabletop that is 1.20 m high. It strikes the floor at a point 1.52 m horizontally from the table edge. (a) How long is the ball in the air? (b) What is its speed at the instant it leaves the table?
30. A trebuchet was a hurling machine built to attack the walls of a castle under siege. A large stone could be hurled against a wall to break apart the wall. The machine was not placed near the wall because then arrows could reach it from the castle wall. Instead, it was positioned so that the stone hit the wall during the second half of its flight. Suppose a stone is launched with a speed of $v_0 = 28.0\text{ m/s}$ and at an angle of $\theta_0 = 40.0^\circ$. What is the speed of the stone if it hits the wall (a) just as it reaches the top of its parabolic path and (b) when it has descended to half that height? (c) As a percentage, how much faster is it moving in part (b) than in part (a)?
35. A projectile's launch speed is five times its speed at maximum height. Find launch angle θ_0 .
53. A ball rolls horizontally off the top of a stairway with a speed of 1.52 m/s . The steps are 20.3 cm high and 20.3 cm wide. Which step does the ball hit first?
66. A particle moves in uniform circular motion, over a horizontal x - y plane. At one instant, it moves through the point at coordinates $(4.00\text{ m}, 4.00\text{ m})$ with a velocity of $(-5.00\text{ m/s})\hat{i}$ and an acceleration of $(+12.5\text{ m/s}^2)\hat{j}$. What are the (a) x and (b) y coordinates of the center of the circular path?
67. A boy whirls a stone in a horizontal circle of radius 1.5 m and at height 2.0 m above level ground. The string breaks, and the stone flies off horizontally and strikes the ground after traveling a horizontal distance of 10 m . What is the magnitude of the centripetal acceleration of the stone?

Chapter 4 Answers

10a) 3.5 m/s
10b) -0.125 m/s^2

20) 60°

24a) 0.495 s
24b) 3.07 m/s

30a) 21.4 m/s
30b) 24.9 m/s
30c) 16.3%

35) 78.5°

53) 3rd step

66a) 4.0 m
66b) center (4.0 m, 6.0 m)

67) 160 m/s^2