p. 880 (11.3)

Find the velocity and acceleration functions for the given position function.

5. $\vec{\mathrm{r}}(t) = \langle 5\cos 2t, 5\sin 2t \rangle$

7. $\vec{\mathrm{r}}(t) = \langle 25t, -16t^2 + 15t + 5 \rangle$

9. $\vec{\mathrm{r}}(t) = \langle 4te^{-2t}, 2e^{-2t}, -16t^2 \rangle$

Find the position function from the given velocity or acceleration function.

11. $\vec{\mathrm{v}}(t) = \langle 10, -32t + 4 \rangle, \ \vec{\mathrm{r}}(0) = \langle 3, 8 \rangle$

13. $\vec{\mathrm{a}}(t) = \langle 0, -32 \rangle, \ \vec{\mathrm{v}}(0) = \langle 5, 0 \rangle, \ \vec{\mathrm{r}}(0) = \langle 0, 16 \rangle$

15. $\vec{\mathrm{v}}(t) = \langle 10, 3e^{-t}, -32t + 4 \rangle, \ \vec{\mathrm{r}}(0) = \langle 0, -6, 20 \rangle$

17. $\vec{\mathrm{a}}(t) = \langle t, 0, -16 \rangle, \ \vec{\mathrm{v}}(0) = \langle 12, -4, 0 \rangle, \ \vec{\mathrm{r}}(0) = \langle 5, 0, 2 \rangle$

Find the centripetal force on an object of mass 10 kg **with the given position function (in units of meters and seconds).**

19. $\vec{\mathrm{r}}(t) = \langle 4\cos 2t, 4\sin 2t \rangle$

21. $\vec{\mathrm{r}}(t) = \langle 6\cos 4t, 6\sin 4t \rangle$

A projectile is fired with initial speed v_0 feet per second from a height of h feet at and angle of θ above the horizontal. Assuming that the only force acting on the object is gravity, find the maximum altitude, horizontal range and speed at impact.

27. $v_0 = 100, \ h = 0, \ \theta = \dfrac{\pi}{3}$

29. $v_0 = 160, \ h = 10, \ \theta = \dfrac{\pi}{4}$

31. $v_0 = 320, \ h = 10, \ \theta = \dfrac{\pi}{4}$

33. Based on your answers to exercises 29 and 31, what effect does doubling the initial speed have on the horizontal range?

35. For $\vec{\mathrm{r}}(t) = \left\langle (v_0 \cos\theta)t, h + (v_0 \sin\theta)t - \dfrac{gt^2}{2} \right\rangle$ with $h = 0,$ show that the horizontal range is $\dfrac{v_0 \sin 2\theta}{g}$.

Neglect all forces except gravity. In these situations, the effort of air resistance is actually significant, but your calculations will give a good first approximation.

37. A baseball is hit from a height of 3 feet with initial speed 120 feet per second and at an angle of 30 degrees above the horizontal. Find a vector-valued function describing the position of the ball *t* seconds after it is hit. To be a home run, the ball must clear a wall that is 385 feet away and 6 feet tall. Determine if this is a home run.

43. A football punt is launched at an angle of 50 degrees with an initial speed of 55 mph. Assuming the punt is launched from ground level, compute the "hang time" (the amount of time in the air) for the punt.

49. A roller coaster is designed to travel a circular loop of radius 100 feet. If the riders feel weightless at the top of the loop, what is the speed of the roller coaster?