HW_3_2D_Motion_Ch_4

Problems: 21, 23, 26, 31, 33, 36, 39, 45, 61, 63, Total = 10

21. A cyclist rides 5.0 km due east, then 10.0 km $20°$ west of north. From this point she rides 8.0 km due west. What is the final displacement from where the cyclist started?

23. The position of a particle is $\vec{\mathbf{r}}\,(t) = 4.0t^2\,\hat{\mathbf{i}} - 3.0\,\hat{\mathbf{j}} + 2.0t^3\,\hat{\mathbf{k}}\,\text{m}$. (a) What is the velocity of the particle at 0 s and at 1.0 s? (b) What is the average velocity between 0 s and 1.0 s?

26. The position of a particle is $\vec{\mathbf{r}}\,(t) = (3.0t^2\,\hat{\mathbf{i}} + 5.0\,\hat{\mathbf{j}} - 6.0t\,\hat{\mathbf{k}})\,\text{m}$. (a) Determine its velocity and acceleration as functions of time. (b) What are its velocity and acceleration at time $t = 0$?

31. A particle has a position function $\vec{\mathbf{r}}\,(t) = \cos(1.0t)\,\hat{\mathbf{i}} + \sin(1.0t)\,\hat{\mathbf{j}} + t\,\hat{\mathbf{k}}$, where the arguments of the cosine and sine functions are in radians. (a) What is the velocity vector? (b) What is the acceleration vector?

33. A bullet is shot horizontally from shoulder height (1.5 m) with and initial speed 200 m/s. (a) How much time elapses before the bullet hits the ground? (b) How far does the bullet travel horizontally?

36. An airplane flying horizontally with a speed of 500 km/h at a height of 800 m drops a crate of supplies (see the following figure). If the parachute fails to open, how far in front of the release point does the crate hit the ground?

39. A projectile is launched at an angle of $30°$ and lands 20 s later at the same height as it was launched. (a) What is the initial speed of the projectile? (b) What is the maximum altitude? (c) What is the range? (d) Calculate the displacement from the point of launch to the position on its trajectory at 15 s.

45. A rock is thrown off a cliff at an angle of $53°$ with respect to the horizontal. The cliff is 100 m high. The initial speed of the rock is 30 m/s. (a) How high above the edge of the cliff does the rock rise? (b) How far has it moved horizontally when it is at maximum altitude? (c) How long after the release does it hit the ground? (d) What is the range of the rock? (e) What are the horizontal and vertical positions of the rock relative to the edge of the cliff at t = 2.0 s, t = 4.0 s, and t = 6.0 s?

61. A particle travels in a circle of radius 10 m at a constant speed of 20 m/s. What is the magnitude of the acceleration?

63. A fairground ride spins its occupants inside a flying saucer-shaped container. If the horizontal circular path the riders follow has an 8.00-m radius, at how many revolutions per minute are the riders subjected to a centripetal acceleration equal to that of gravity?