Chapter 3

Problems & Exercises

1.

(a) 480 m

(b) 379 m, 18.4º east of north

3.

north component 3.21 km, east component 3.83 km

5.

19.5 m, 4.65º south of west

7.

(a) 26.6 m, 65.1º north of east

(b) 26.6 m, 65.1º south of west

9.

52.9 m, 90.1º with respect to the x-axis.

11.

x-component 4.41 m/s

y-component 5.07 m/s

13.

(a) 1.56 km

(b) 120 m east

15.

North-component 87.0 km, east-component 87.0 km

17.

30.8 m, 35.8 west of north

19.

(a) 30.8 m, 54.2 south of west

(b) 30.8 m, 54.2 north of east

21.

18.4 km south, then 26.2 km west(b) 31.5 km at 45.0 south of west, then 5.56 km at 45.0 west of north

23.

7.34 km, 63.5 south of east

25.

$$
\begin{aligned}
x &= 1.30 \text{ m} \times 10^2 \\
y &= 30.9 \text{ m.}
\end{aligned}
$$

27.

(a) 3.50 s

(b) 28.6 m/s (c) 34.3 m/s

(d) 44.7 m/s, 50.2 below horizontal

29.

(a) 18.4º

(b) The arrow will go over the branch.

31.

$$R = \frac{v_0^2}{\sin 2\theta_0 g}$$

For $\theta = 45^\circ$, $\quad R = \frac{v_0^2}{g}$

$R = 91.8$ m for $v_0 = 30$ m/s; $R = 163$ m for $v_0 = 40$ m/s; $R = 255$ m for $v_0 = 50$ m/s.

33.

(a) 560 m/s

(b) 8.00×10^3 m

(c) 80.0 m. This error is not significant because it is only 1% of the answer in part (b).

35.

1.50 m, assuming launch angle of 45

37.

$\theta = 6.1$

yes, the ball lands at 5.3 m from the net

39.

(a) −0.486 m

(b) The larger the muzzle velocity, the smaller the deviation in the vertical direction, because the time of flight would be smaller. Air resistance would have the effect of decreasing the time of flight, therefore increasing the vertical deviation.

41.

4.23 m. No, the owl is not lucky; he misses the nest.

43.

No, the maximum range (neglecting air resistance) is about 92 m.

45.

15.0 m/s

47.

(a) 24.2 m/s

(b) The ball travels a total of 57.4 m with the brief gust of wind.

49.

$y - y_0 = 0 = v_{0y}t - \frac{1}{2}gt^2 = (v_0 \text{ sin } \theta)t - \frac{1}{2}gt^2$,

so that $t = \frac{2(v_0 \text{ sin } \theta)}{g}$

$x - x_0 = v_{0x}t = (v_0 \text{ cos } \theta)t = R$, and substituting for t gives:

$R = v_0 \text{ cos } \theta \left(\frac{2v_0 \text{ sin } \theta}{g}\right) = \frac{2v_0^2 \text{ sin } \theta \text{ cos } \theta}{g}$

since 2 sin θ cos θ = sin 2θ, the range is:

$R = \frac{{v_0}^2 \text{ sin } 2\theta}{g}$.

52.

(a) 35.8 km, 45º south of east

(b) 5.53 m/s, 45º south of east

(c) 56.1 km, 45º south of east

54.

(a) 0.70 m/s faster

(b) Second runner wins

(c) 4.17 m

56.

17.0 m/s, 22.1

58.

(a) 230 m/s, 8.0 south of west

(b) The wind should make the plane travel slower and more to the south, which is what was calculated.

60.

(a) 63.5 m/s

(b) 29.6 m/s

62.

6.68 m/s, 53.3 south of west

64.

(a) $H_{\text{average}} = 14.9\frac{\text{km/s}}{\text{Mly}}$

(b) 20.2 billion years

66.

1.72 m/s, 42.3 north of east

71.

(a) Since $\sin^2 50 > \sin^2 40$, then B reaches the greatest height.

(b) i. Yes, it is consistent because $\sin 50 > \sin 40$. ii. No, it does not make sense because y is proportional to $\sin^2\theta$.

(c)