Homework Solutions
9/1/2006

Conceptual Questions

15. The velocities of the balls are equal when they hit the ground because the ball thrown upward will pass the release point with the same velocity downward, as if it was thrown downward.

19. The balls will meet above the starting point because while they will have traveled in the air the same amount of time, the ball thrown upward begins with a higher speed than the dropped ball and will cover more distance before the two balls meet.

Problems

48. a.

$$t_{total} = 2.00s$$

$$t_{top} = 1.00s$$

$$v = v_0 + at$$

$$v - at = v_0$$

$$v_0 = 0 - \left(-9.81\frac{m}{s^2}\right)(1.00s) = 9.81\frac{m}{s}$$

b.

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$x = 0 + \left(9.81\frac{m}{s}\right)(1.00s) - 4.905\frac{m}{s^2}(1.00s)^2$$

$$x = 4.91m$$

57. a.

$$15m - h = x_{fallingball}$$

$$x = \frac{1}{2}gt^2$$

$$15m - h = \frac{1}{2}gt^2$$

$$h = 15m - \frac{1}{2}gt^2$$

$$x_{thrownball} = v_0 t + \frac{1}{2}gt^2$$

$$h = \left(25\frac{m}{s}\right)t + \frac{1}{2}gt^2$$

Combining the two relationships for height allows us to solve for t.

$$15m + \frac{1}{2}gt^2 = \left(25\frac{m}{s}\right)t + \frac{1}{2}gt^2$$

$$t = \frac{15m}{25\frac{m}{s}} = 0.60s$$

62. a.

$$t_a = t_b - 1s$$

$$v^2 = v_0^2 + 2ax$$

$$v = \sqrt{v_0^2 + 2ax}$$

$$v = \sqrt{\left(-2.00\frac{m}{s}\right)^2 + 2\left(-9.81\frac{m}{s^2}\right)(-50.0m)}$$

$$v = -31.38\frac{m}{s}$$

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a} = \frac{-31.38\frac{m}{s} - \cdot 2.00\frac{m}{s}}{9.81\frac{m}{s^2}} = 2.99s$$

b.

$$t_b = 2.99s - 1.00s = 1.99s$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$v_0 = \frac{x - \frac{1}{2}at^2}{t}$$

$$v_0 = \frac{-50.0m - \left(-4.905\frac{m}{s^2}\right)(1.99s)^2}{1.99s} = -15.36\frac{m}{s}$$

$$v_0 = -15.4\frac{m}{s}$$

c.

$$v_{a,final} = -31.4\frac{m}{s}$$

$$v = v_0 + at$$

$$v_{b,final} = -15.36\frac{m}{s} - 9.81\frac{m}{s^2}(1.99s)$$

$$v_{b,final} = -34.88\frac{m}{s} = -34.9\frac{m}{s}$$

67. a.

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$x_o = 0m$$

$$v_0 = 0\frac{m}{s}$$

$$t = \sqrt{\frac{2x}{a}} = \sqrt{\frac{2(-3.00m)}{-9.81\frac{m}{s^2}}} = 0.7821s$$

$$v = \frac{x}{t}$$

$$x = vt = \left(10.0\frac{m}{s}\right)(0.7821s) = 7.821m = 7.82m$$