Homework Solutions
9/5/2007

Problems

31. Accelerating down the inline

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

$$v = \sqrt{2ax} = \sqrt{2\left(4.00\frac{m}{s^2}\right)(50.0m)} = 20.0\frac{m}{s}$$

Leaving the cliff, we first find the initial vertical and horizontal velocities. Then we find the final vertical velocity as the car hits the base and use that with the initial vertical velocity to find the time in the air.

$$v_y = 20.0\frac{m}{s}\sin 24.0° = -8.135\frac{m}{s}$$

$$v_x = 20.0\frac{m}{s}\cos 24.0° = 18.27\frac{m}{s}$$

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

$$v = \sqrt{v_0^2 + 2ax} = \sqrt{\left(-8.135\frac{m}{s}\right)^2 + 2\left(-9.81\frac{m}{s^2}\right)(-30.0m)} = 25.59\frac{m}{s}$$

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a} = \frac{-25.59\frac{m}{s} - \left(-8.135\frac{m}{s}\right)}{-9.81\frac{m}{s^2}} = 1.779s = 1.78s$$

$$x = vt = 18.27\frac{m}{s}(1.779s) = 32.5m$$

57.

$$v_x = 20\frac{m}{s}\cos 30° = 17.32\frac{m}{s}$$

$$v_y = 20\frac{m}{s}\sin 30° = 10.\frac{m}{s}$$

$$v = v_o + at$$

$$t_{up} = \frac{v - v_0}{a} = \frac{0 - 10\frac{m}{s}}{-9.81\frac{m}{s^2}} = 1.019s$$

$$t_{total} = 2 \bullet 1.019s = 2.038s$$

$$x = vt = 17.32\frac{m}{s}(2.038s) = 35.3m$$

$$x_{receiver} = 35.3m - 20.m = 15.3m$$

$$v_{receiver} = \frac{x}{t} = \frac{15.3m}{2.038s} = 7.5\frac{m}{s}$$

The receiver should run away from the quarterback 7.5m/s in order to catch the ball.

58. Because we don't know the initial velocity the ball was shot with, we must write all other values in terms of v. Once we write our unknown values in terms of v (horizontal and vertical velocities and time), we can solve for v.

$$v_x = v\cos 45°$$

$$v_y = v\sin 45°$$

$$x = v_x t$$

$$x = \cos 45° \bullet t$$

$$t = \frac{x}{v\cos 45°}$$

$$y = 1.05m$$

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

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

$$y = v\sin 45°\left(\frac{x}{v\cos 45°}\right) + \frac{1}{2}a\left(\frac{x}{v\cos 45°}\right)^2$$

$$y = x + \frac{1}{2}a\left(\frac{x^2}{v^2\cos^2 45°}\right)$$

$$y - x = \frac{1}{2}a\left(\frac{x^2}{v^2\cos^2 45°}\right)$$

$$v^2 = \frac{1}{2}a\left(\frac{x^2}{(y-x)\cos^2 45°}\right)$$

$$v = \sqrt{\frac{1}{2}a\left(\frac{x^2}{(y-x)\cos^2 45°}\right)} = 10.5\frac{m}{s}$$

62.

$$v_x = v_0 \cos\theta$$

$$v_y = v_0 \sin\theta$$

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

$$x = \frac{v^2 - v_{0,y}^2}{2a}$$

$$h = \frac{0^2 - (v_0 \sin\theta)^2}{2g} = \frac{v_0^2 \sin^2\theta}{2g}$$

$$x = v_x t$$

$$v = v_{0,y} + at$$

$$t_{up} = \frac{v - v_{0,y}}{a} = \frac{-v_0 \sin\theta}{g}$$

$$t_{total} = \frac{-2v_0 \sin\theta}{g}$$

$$x = v_0 \cos\theta \left(\frac{-2v_0 \sin\theta}{g} \right)$$

$$R = \frac{-2v_o^2 \sin\theta \cos\theta}{g} = \frac{-v_0^2 \sin 2\theta}{g}$$

Since we've defined g to be negative, this result will yield the same as the result in the book.