Answer on Question #60032-Physics-Mechanics-Relativity

A clown in circus juggles with n balls using only one hand. He throws each ball vertically upwards with the same speed V at equal time intervals T. Denote acceleration of free fall by g.

(a) Find expressions for the speed of projection and height of the i th ball above his hand when he throws the n th ball.

Let he uses n = 4 balls and when he throws the fourth ball, the distance between the second and third ball is d = 50 cm.

(b) Where is the first ball, when the juggler throws the fourth ball?

(c) What is maximum height attained by each ball above the hands of the juggler?

Solution

(a)

$$v = V - gt, h = Vt - \frac{gt^2}{2}.$$

$$t = T(n - i).$$

The total time of flight is

$$\tau = nT.$$

At this time:

$$v = V - gnT = -V$$

$$V = \frac{gnT}{2}$$

Therefore,

$$h = Vt - \frac{gt^2}{2} = \frac{gnT}{2}T(n - i) - \frac{g}{2}T^2(n - i)^2 = \frac{gT^2 i(n - i)}{2}$$

(b)

$$h(2) = \frac{gT^2 2(4 - 2)}{2} = 2gT^2$$

$$h(3) = \frac{gT^2 3(4 - 3)}{2} = \frac{3}{2}gT^2$$

$$d = 2gT^2 - \frac{3}{2}gT^2 = \frac{1}{2}gT^2.$$

$$h(1) = \frac{gT^2 1(4 - 1)}{2} = \frac{3}{2}gT^2 = 3d = 150\ cm = 1.5\ m.$$

(c)

$$H = h\left(\frac{\tau}{2}\right) = h\left(\frac{nT}{2}\right) = h\left(\frac{4T}{2}\right) = h(2T) = \frac{g4T}{2}2T - \frac{g}{2}(2T)^2 = 2gT^2$$

$$H = 4d = 2\ m.$$