



## Thomas wants to bounce balls...

Thomas has two plastic balls.  
 The radii of the balls are  $R_1 = 3R = 0.3$  m and  $R_2 = R = 0.1$  m.  
 Their masses are  $3m = 0.03$  kg and  $m = 0.01$  kg.  
 Thomas places the small ball on top of the large ball.

At  $t = 0$ , Thomas releases the two balls from a height  $h = 3.2$  m.  
 The vertical positions of the centers are denoted by  $z_1(t)$  and  $z_2(t)$ .

At  $t = t_*$ , the large ball reaches the ground.  
 The collisions are **perfectly elastic**.  
 These collisions are also **instantaneous and successive**.  
 After the impacts, the balls have two distinct velocities  $v_1^+ < v_2^+$ .  
 Then a periodic bouncing motion sets in.  
 The period of this motion is  $T$ .

In the calculations, we will use  $g = 10$  m/s<sup>2</sup>.

1. Compute the time  $t_*$  corresponding to the free fall of the two balls.
2. Compute the speed  $v$  before the collision, then the speeds  $v_1^+$  and  $v_2^+$ .
3. Plot the curves  $z_1(t) - 3R$  and  $z_2(t) - 7R$ .  
 What is the maximum height reached by the small ball?  
 What is the period  $T$  of the bouncing motion?