Problem Sheet No. 8

1. Determine the coefficient of restitution *e* for a steel ball dropping from rest at a height *h* above a heavy horizontal steel plate if the height of the second rebound is h_2.

   Ans. $e = \left(\frac{h_2}{h}\right)^{1/4}$

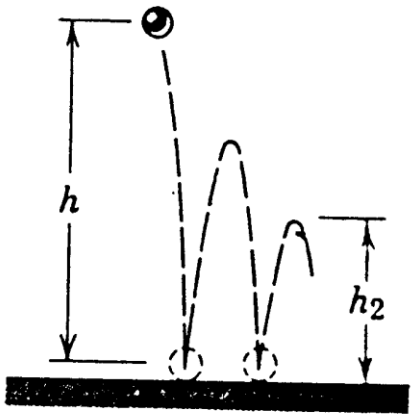


Figure-1

2. The previous problem is modified in that the plate struck by the ball now has a mass equal to that of the ball and is supported as shown. Compute the final velocities of both the masses immediately after the impact if the plate is initially stationery and all other condition are same as stated in the previous problem.

   Ball, $v_1' = 12.20$ m/s, $\theta = -9.83°$

   Plate, $v_2' = 18.71$ m/s down

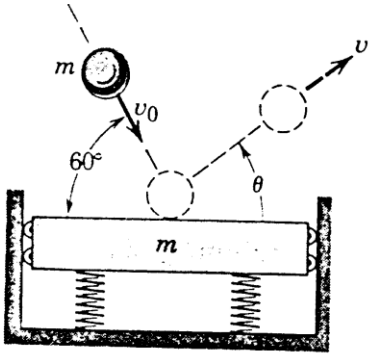


Figure-2

3. The figure shown *n* spheres of equal mass *m* suspended in a line by wire of equal length so that the spheres are almost touching each other. If sphere 1 is released from the dotted position and strikes sphere 2 with a velocity v_1, write an expression for the velocity v_n of the nth sphere immediately after it struck by the one adjacent to it. The common coefficient of restitution is *e*.

   Ans. $v_n = \left(\frac{1+e}{2}\right)^{n-1} v_1$

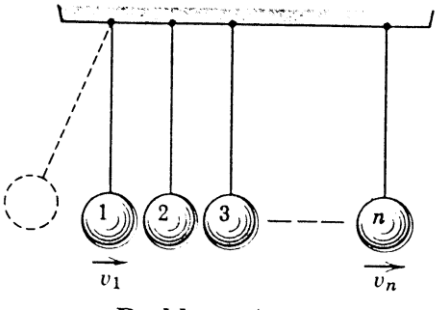
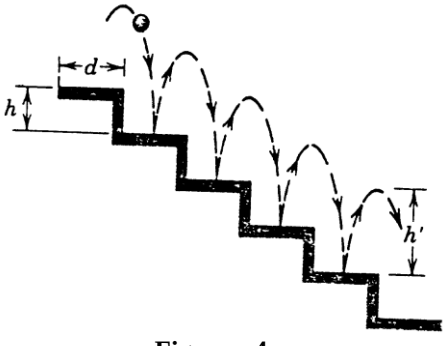


Figure-3

4. Determine the coefficient of restitution e that ill allow the ball to bounce down the steps as shown. The tread and riser dimensions, d and h, respectively, are the same for every step, and the ball bounces the same distance h′ above each steps. What horizontal velocity vx is required so that the ball lands in the center of each tread?

   Ans. $e = \sqrt{\frac{h'}{h'+h'}}, v_x = \frac{\sqrt{\frac{g}{2}d}}{\sqrt{h'} + \sqrt{h'+h}}$



Figuure-4

5. During a pregame warmup period, two basketballs collide above the hoop when in the positions shown. Just before impact, ball 1 has the velocity v_1 that makes a 30˚ angle with the horizontal. If the velocity v_2 of ball 2 just before impact have the same magnitude as v_1, determine the two possible values of the angle θ, measured from the horizontal, that will cause ball 1 to go directly through the center of the basket. The coefficient of restitution is $e = 0.8$.
Ans. θ = 82.3˚ or –22.3˚

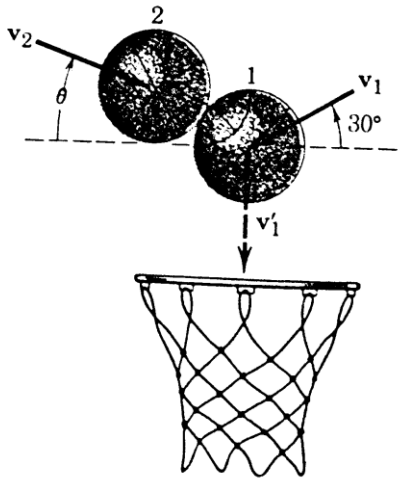


Figure-5