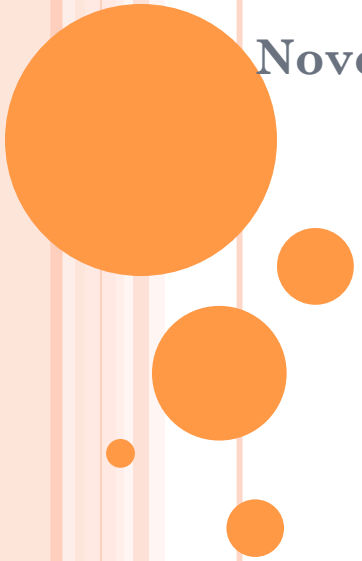
Physics 1A, Section 2

November 4, 2010



QUIZ #3

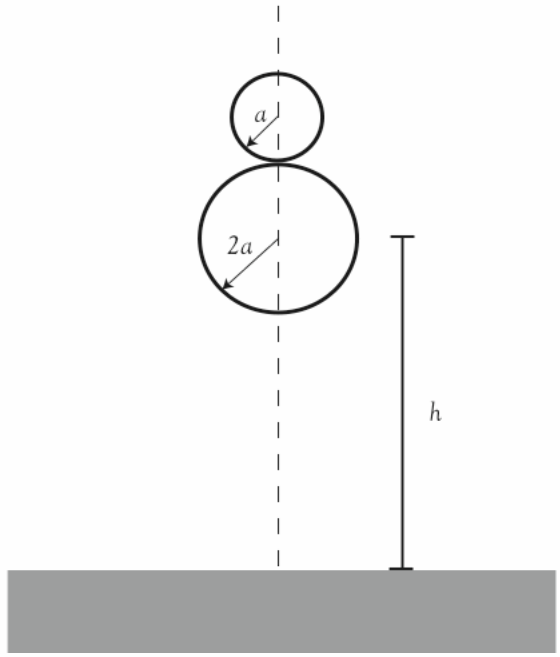
- covers:
  - Frautschi chapters 8.5 – 10 (and earlier)
  - lectures/sections through Monday (Nov. 1)
  - homework #4-5 (and earlier)

Crash Course in Collision Problems

- Assume collision happens in an instant.
  - Describe "before" and "after" cases, nearly simultaneous.
  - During collision, ignore relatively weak external forces, compared to strong impulsive forces.
- Momentum is conserved:
  - $\Sigma\, m_j \mathbf{v}_j = \mathbf{constant}$
- Kinetic energy:
  - elastic: $\Sigma\, {}^1/_2\, m_j v_j^2 = \text{constant}$
  - (partially) inelastic: $\Sigma\, {}^1/_2\, m_j v_j^2$ decreases
  - completely inelastic: objects stick to each other

Quiz Problem 38

Two balls, the lower one of radius $2a$ and the upper one of radius a, are dropped from a height h (measured from the center of the lower ball to the floor), as shown in the figure. The mass of the upper ball is m and the mass of the lower ball is $M = 3m$. Assume that the centers of the spheres always lie along the vertical line and that all collisions are perfectly elastic. You may neglect air resistance.



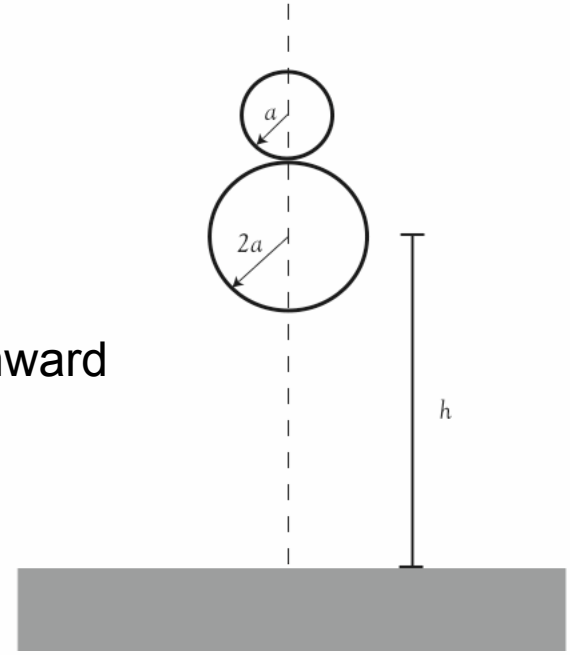
(a) (1 point) Calculate the velocity v_0 of the balls immediately before they hit the floor. Assume there is a short interval between the lower ball bouncing on the floor and it hitting the upper ball. What is the velocity of the lower ball immediately after hitting the floor but before hitting the upper ball?

(b) (3 points) Immediately after the lower ball hits the upper ball, what will the velocity v_1 be for the upper ball?
Hint: It might be less cumbersome to compute this in terms of v_0, substituting the answer to part **(a)** only at the very end.

(c) (2 points) How high will the upper ball bounce? Express the answer H in terms of h and a. (Measure H from floor level to the upper ball's center at its highest position.)

Quiz Problem 38

Two balls, the lower one of radius $2a$ and the upper one of radius a, are dropped from a height h (measured from the center of the lower ball to the floor), as shown in the figure. The mass of the upper ball is m and the mass of the lower ball is $M = 3m$. Assume that the centers of the spheres always lie along the vertical line and that all collisions are perfectly elastic. You may neglect air resistance.



(a) (1 point) Calculate the velocity v_0 of the balls immediately before they hit the floor. Assume there is a short interval between the lower ball bouncing on the floor and it hitting the upper ball. What is the velocity of the lower ball immediately after hitting the floor but before hitting the upper ball?

(b) (3 points) Immediately after the lower ball hits the upper ball, what will the velocity v_1 be for the upper ball?
Hint: It might be less cumbersome to compute this in terms of v_0, substituting the answer to part **(a)** only at the very end.

(c) (2 points) How high will the upper ball bounce? Express the answer H in terms of h and a. (Measure H from floor level to the upper ball's center at its highest position.)

- Answer:

a) $v_0 = \text{sqrt}[2g(h-2a)]$
before ball collision: M upward, m downward

a) $v_1 = v_0\,(3M-m)/(M+m) = 2v_0$

b) height = 4h – 3a

Monday, November 10:

- Final Problem 19 (collision + oscillatory motion)
- Quiz Problem 53 (oscillatory motion)

- *Optional, but helpful, to try these in advance.*