

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01 TEAL

Fall Term 2004

In-Class Problems 24-26: Momentum and Collisions

Section _____ Table and Group Number _____

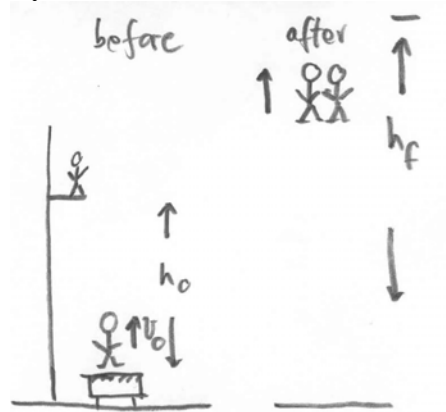
Names _____

Hand in one solution per group.

We will work on these problems during the presentation. Would you prefer Monday in-class problems to be incorporated into the presentation or would you prefer to do the problems separately after the presentation? Please include comments from all the group members.

Problem 24: Momentum and Mechanical Energy

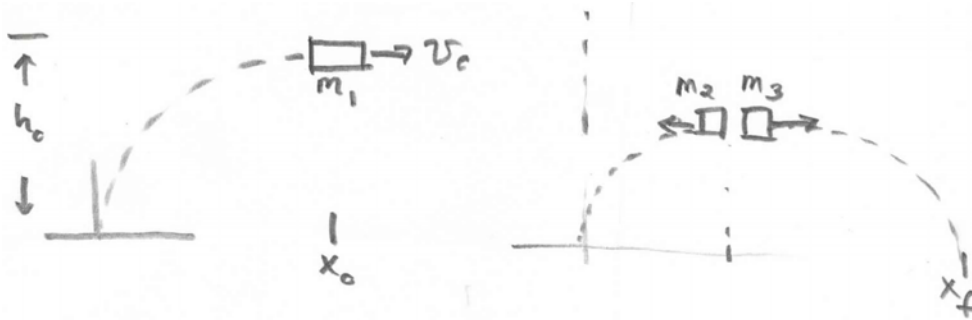
An acrobat of mass m_A jumps upwards off a trampoline with an initial velocity v_0 . At a height h_0 , the acrobat grabs a clown of mass m_B . Assume that the time the acrobat takes to grab the clown is negligibly small.



- What is the velocity of the acrobat immediately before grabbing the clown?
- What is the velocity of the acrobat immediately after grabbing the clown?
- How high do the acrobat and clown rise? How high would the acrobat go in the limit that the mass of the acrobat is much heavier than the mass of the clown?
- If the acrobat missed the clown, how high would the acrobat go? How does this compare to your limit in part c)?

Problem 25: Exploding Projectile

An instrument-carrying projectile of mass m_1 accidentally explodes at the top of its trajectory. The horizontal distance between launch point and the explosion is x_0 . The projectile breaks into two pieces which fly apart horizontally. The larger piece, m_3 , has three times the mass of the smaller piece, m_2 . To the surprise of the scientist in charge, the smaller piece returns to earth at the launching station. Neglect air resistance and effects due to the earth's curvature.



- What is the velocity of the projectile at the top of its flight just before the collision?
- What is the velocity of the smaller piece just after the collision?
- What is the velocity of the larger piece just after the collision?
- How far away, x_f , from the original launching point does the larger piece land?

Problem 26: Bouncing Superballs

Two superballs are dropped from a height above the ground. The ball on top has a mass m_1 . The ball on the bottom has a mass m_2 . Assume that the lower ball collides elastically with the ground. Then as the lower ball starts to move upward, it collides elastically with the upper ball that is still moving downwards. How high will the upper ball rebound in the air? Assume that $m_2 \gg m_1$. Hint: consider this collision from an inertial reference frame that moves upward with the same speed as the lower ball has after it collides with ground. What speed does the upper ball have in this reference frame after it collides with the lower ball?

