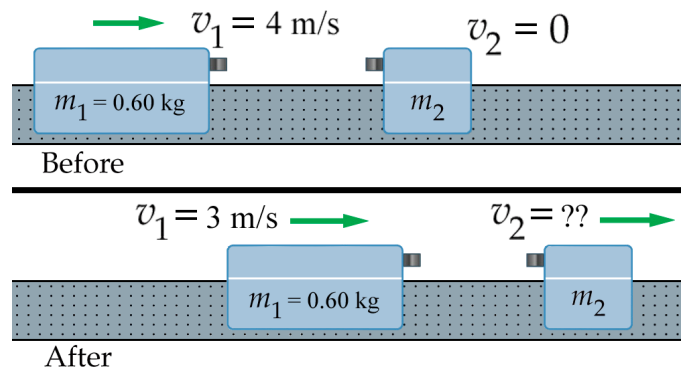


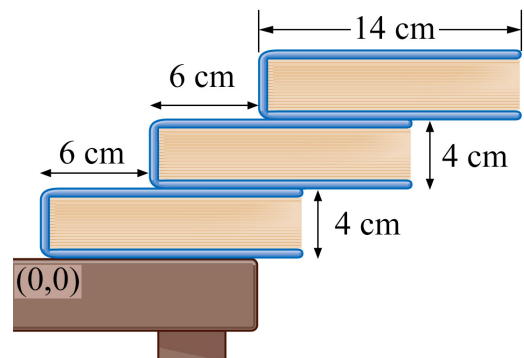
Quiz #4, Physics 135-1, Fall 2009, Solutions

1) Two gliders are on a frictionless air track. The first glider has a mass of 0.60 kg and a velocity of 4 m/s when it strikes the second, which is motionless. After impact, the velocity of the first glider is 3 m/s. If the collision was perfectly elastic, what is the mass and "after" velocity of the second glider?



Solution: Conservation of momentum gives us $(0.6 \text{ kg})(4 \text{ m/s}) + 0 = (0.6 \text{ kg})(3 \text{ m/s}) + m_2 v_2$, or $0.6 = m_2 v_2$. Conservation of kinetic energy gives us $\frac{1}{2}(0.6 \text{ kg})(4 \text{ m/s})^2 + 0 = \frac{1}{2}(0.6 \text{ kg})(3 \text{ m/s})^2 + \frac{1}{2} m_2 v_2^2$, or $4.2 = m_2 v_2^2$. Substitution for m_2 yields $4.2 = (0.6/v_2)v_2^2 = 0.6 v_2$, or $v_2 = 7 \text{ m/s}$. $m_2 = 0.6/v_2 = 0.0857 \text{ kg}$.

2) Three exactly identical books are stacked on a table as shown. They have rectangular dimensions of 4 cm high by 14 cm long, as viewed from the side, and you may assume that the mass distribution of each book is perfectly uniform. They are stacked such that the upper books are shifted 6 cm to the right relative to the book just below. If we take the coordinate origin to be at the bottom left corner of the bottom book, what are the (x, y) coordinates of the center of mass of the three books taken together?



Solution: From symmetry, the x -coordinate of the CM of the bottom book is $x = 7 \text{ cm}$. The corresponding coordinates for the next two books are $7 + 6 = 13 \text{ cm}$, and $13 + 6 = 19 \text{ cm}$. If m is the mass of each book, then we have $x_{\text{CM}} = [m(7 \text{ cm}) + m(13 \text{ cm}) + m(19 \text{ cm})] / 3m = 13 \text{ cm}$. Similarly, we can calculate the y -coordinate as $y_{\text{CM}} = [m(2 \text{ cm}) + m(6 \text{ cm}) + m(10 \text{ cm})] / 3m = 6 \text{ cm}$. It is also possible to deduce these coordinates just by examining the positions of the three books and recognizing that the first and third books are offset by equal amounts but in opposite directions from the second book, therefore the CM of the second book is also the CM of all three books together.