

AP[®] PHYSICS B
2002 FORM B SCORING GUIDELINES

Question 1

15 points total	Distribution of points
(a) 4 points	
For any statement indicating that impulse equals change in momentum	1 point
For any statement indicating that impulse can be determined from the area under the graph	1 point
$\Delta p = F \Delta t = \text{area under the curve}$	
$\Delta p = 2 \left(\frac{1}{2} \right) (0.5 \times 10^{-3} \text{ s}) (10 \times 10^3 \text{ N}) = 5 \text{ N}\cdot\text{s}$	
For recognizing that the impulse on the 2 kg cart is negative, and subtracting it from the initial momentum of the cart	1 point
$p_{2 \text{ kg after}} = (2.0 \text{ kg})(3.0 \text{ m/s}) - 5 \text{ N}\cdot\text{s} = 1 \text{ N}\cdot\text{s}$	
$p_{2 \text{ kg after}} = (2 \text{ kg})v_{2 \text{ kg after}} = 1 \text{ N}\cdot\text{s}$	
For the correct answer	1 point
$v_{2 \text{ kg after}} = 0.5 \text{ m/s to the right}$	
(b) 3 points	
For any statement of conservation of momentum	1 point
$p_{2 \text{ kg before}} = p_{2 \text{ kg after}} + p_{m \text{ after}}$	
For correct substitutions	1 point
$6 \text{ N}\cdot\text{s} = 1 \text{ N}\cdot\text{s} + m(1.6 \text{ m/s})$	
For the correct answer	1 point
$m = 3.1 \text{ kg}$	
<i>Alternate solution</i>	<i>Alternate points</i>
The average acceleration is the average force divided by the mass	
$\bar{a} = \bar{F}/m$	
For calculating the average acceleration	1 point
$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{1.6 \text{ m/s}}{1 \times 10^{-3} \text{ s}} = 1600 \text{ m/s}^2$	
For calculating the average force	1 point
$\bar{F} = \frac{1}{2}(0 + 10,000) \text{ N} = 5000 \text{ N}$	
$m = (5000 \text{ N}) / (1600 \text{ m/s}^2)$	
For the correct answer	1 point
$m = 3.1 \text{ kg}$	

Note: An alternate solution is to do part (b) first using impulse, in which case the first two points noted above for part (a) could be earned. Then conservation of momentum can be used to solve part (a), so the first point noted above for part (b) could be earned.