

Begin your response to **QUESTION 5** on this page.

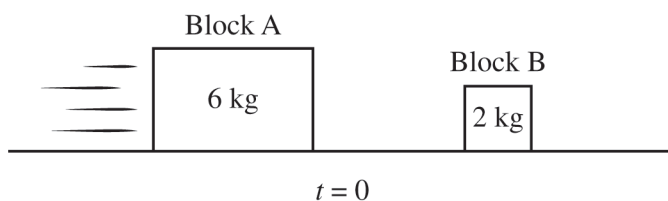


Figure 1

5. (7 points, suggested time 13 minutes)

At time $t = 0$, Block A slides along a horizontal surface toward Block B, which is initially at rest, as shown in Figure 1. The masses of blocks A and B are 6 kg and 2 kg, respectively. The blocks collide elastically at $t = 1.0$ s, and as a result, the magnitude of the change in kinetic energy of Block B is 9 J. All frictional forces are negligible.

(a) **Determine** the speed of Block B immediately after the collision.

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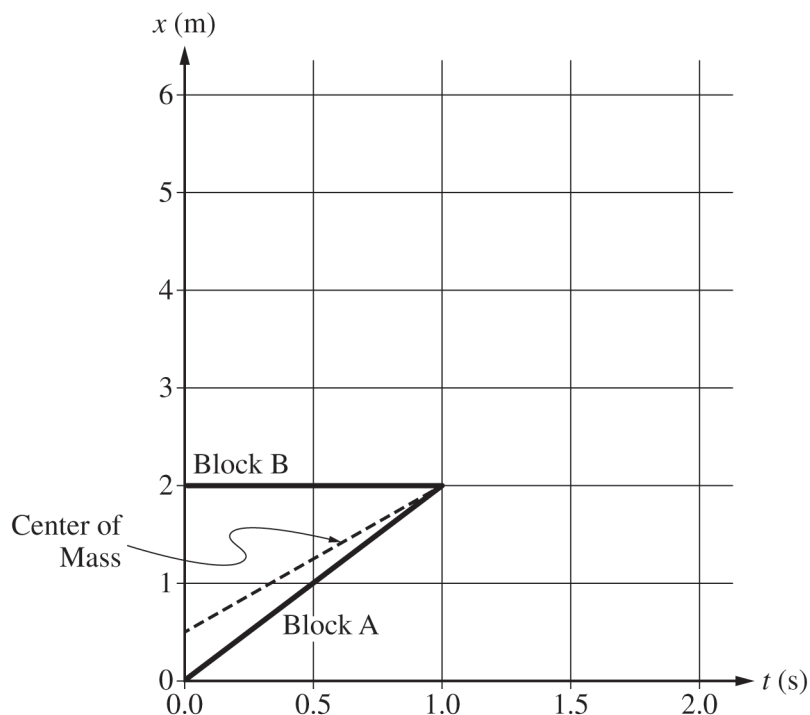


Figure 2

The graph shown in Figure 2 represents the positions x of Block A, Block B, and the center of mass of the two-block system as functions of t between $t = 0$ and $t = 1.0$ s.

- (b) On the graph in Figure 2, **draw** and **label** three lines to represent the positions of Block A, Block B, and the center of mass of the two-block system as functions of t between $t = 1.0$ s and $t = 2.0$ s. Each line should be distinctly labeled.
- (c) Consider if in the original scenario, instead of colliding elastically, the blocks collided and stuck together. **Describe** how the line drawn for the center of mass in part (b) would change, if at all. Briefly **justify** your response.

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Question 5: Short Answer**7 points**

- (a) For determining the speed of Block B to be 3 m/s **1 point**

Example Response

$$\frac{1}{2}(2 \text{ kg})v_f^2 = 9 \text{ J}$$

$$v_f = 3 \text{ m/s}$$

Total for part (a) 1 point

- (b) For drawing and labeling a straight line for the position of Block A with a lesser positive slope than the slope of its pre-collision line **1 point**

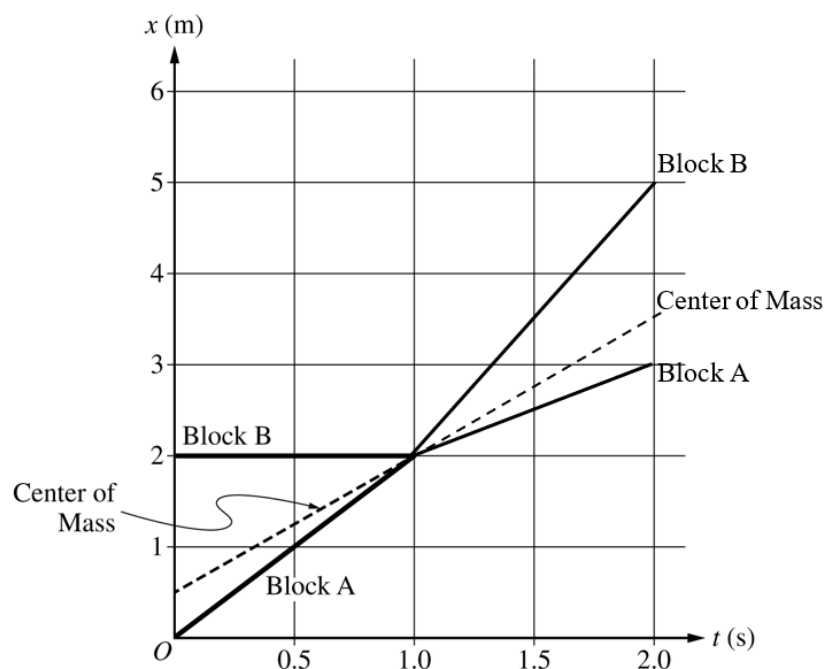
Scoring Note: The correct slope is not required to earn this point.

For drawing and labeling a straight line for the position of Block B with a positive, nonvertical slope **1 point**

Scoring Note: The correct slope is not required to earn this point.

For drawing a straight line for the center of mass of the two-block system position with the same slope as the pre-collision line **1 point**

For drawing lines for Block A and Block B with the correct slopes, 1 m/s and 3 m/s, respectively, that begin at $t = 1.0 \text{ s}$ and $x = 2 \text{ m}$ **1 point**

Example Response**Total for part (b) 4 points**

(c)	For indicating the line drawn for the center of mass of both two-block systems is the same	1 point
	For an explanation that indicates one of the following:	1 point
	<ul style="list-style-type: none">• Momentum is conserved in an inelastic collision• No external forces exerted on the two-block system	
	Example Response	
	<i>The slope of the line drawn for the center of mass would remain the same as the that of the elastic collision because momentum is conserved. The lines for Block A and Block B would lie along the center of mass line because the blocks slide together.</i>	
	Total for part (c)	2 points
	Total for question 5	7 points