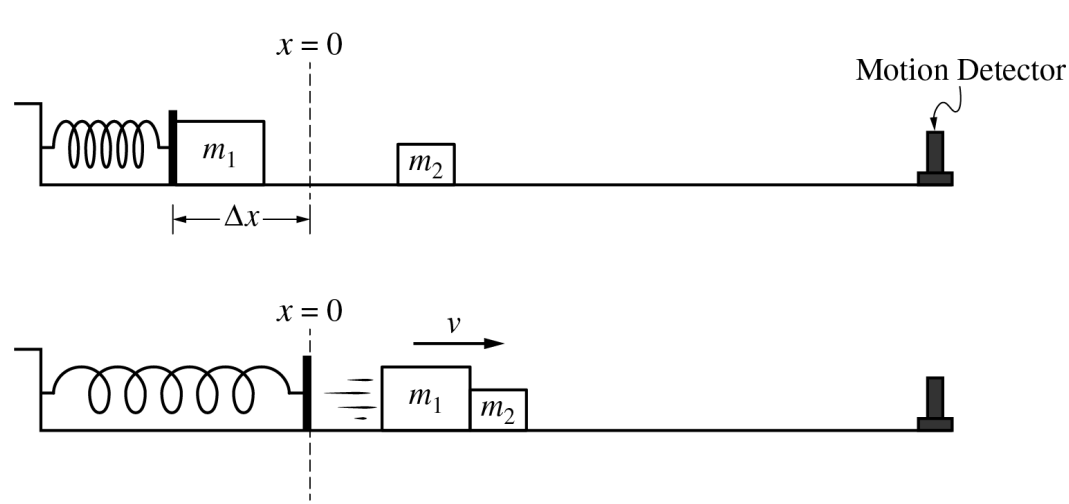




Block 1 of mass m_1 is held at rest while compressing an ideal spring an amount Δx . The spring constant of the spring is k . Block 2 has mass m_2 , where $m_2 < m_1$. At time $t = 0$, Block 1 is released. At time t_C , the spring is no longer compressed and Block 1 immediately collides with and sticks to Block 2. The blocks stick together and the two-block system moves with constant speed v , as shown. Frictional effects are negligible.

- (a) The impulse on Block 1 from the spring during the time interval $0 < t < t_C$ is J_S . The impulse on Block 1 from Block 2 during the collision is J_2 . Which of the following expressions correctly compares the magnitudes of J_S and J_2 ?

☐ $J_S > J_2$

 ☐ $J_S < J_2$

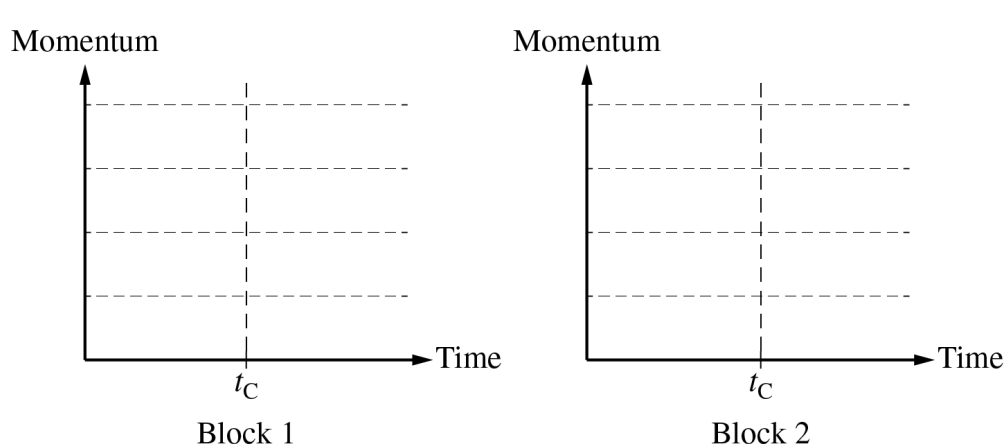
 ☐ $J_S = J_2$

Justify your answer.

GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 2** on this page.

- (b) On the following axes, draw graphs of the magnitude of the momentum of each block as a function of time, before and after t_C . The collision occurs in a negligible amount of time. The grid lines on each graph are drawn to the same scale.

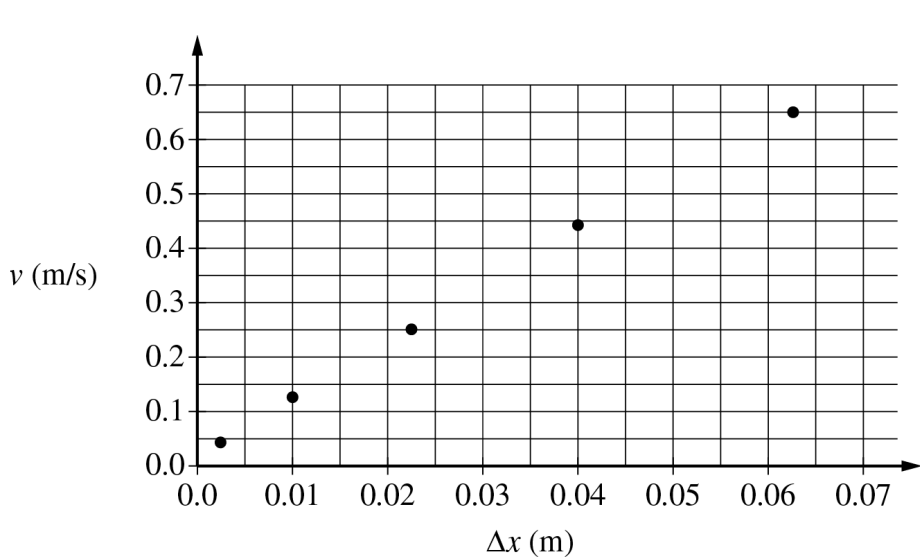


- (c) Show that the velocity v of the two-block system after the collision is given by the equation $v = \frac{\sqrt{km_1}}{m_1 + m_2} \Delta x$.

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Continue your response to **QUESTION 2** on this page.

- (d) A group of students use the setup to perform an experiment. They measure the mass of Block 1 to be $m_1 = 0.500$ kg, and the spring constant k of the spring to be 150 N/m. The mass of Block 2 is unknown. They perform several trials and in each trial the spring is compressed a different distance Δx and the final velocity v of the two-block system is measured. They graph v as a function of Δx , as shown below.



- Draw a line that represents the best fit to the data points shown.
- Use the best-fit line to calculate the mass of Block 2.

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Continue your response to **QUESTION 2** on this page.

- (e) After the experiment, the students use a balance to measure the mass of Block 2 and find it to be greater than what was determined in part (d). To explain this discrepancy, one of the students proposes that the spring constant was incorrectly measured at the beginning of the experiment. The students measure the spring constant again and record a new value, k' .

Should the students expect that k' be greater than 150 N / m, less than 150 N / m, or equal to 150 N / m ?

☐ $k' > 150$ N / m
 ☐ $k' < 150$ N / m
 ☐ $k' = 150$ N / m

Justify your answer.

GO ON TO THE NEXT PAGE.