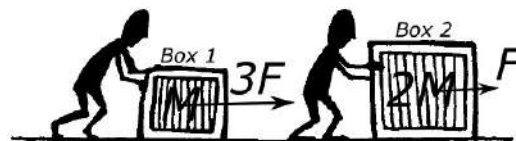


NAME \_\_\_\_\_

DATE \_\_\_\_\_

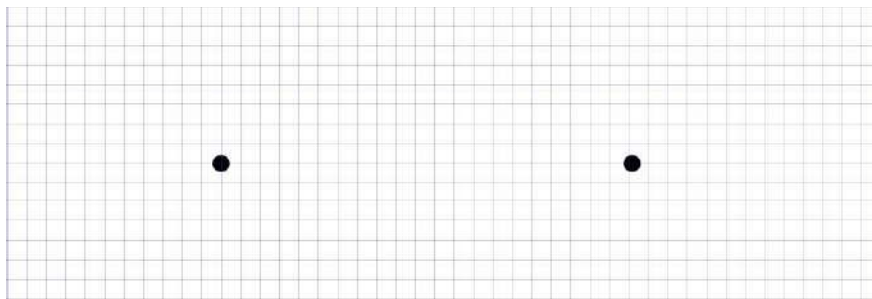
**Scenario**

Two different boxes are pushed from rest on a frictionless surface for a time  $t$ , with differing forces.

**Using Representations**

**PART A:** Identify the box system by circling the objects inside the system with a dotted circle.

**PART B:** The dots below represent the two boxes. Draw free-body diagrams showing and labeling the forces (not components) exerted on each box. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces. Identify the external forces.



Forces that are external to the system include: \_\_\_\_\_

**PART C:** Sketch a graph of the net external force vs.  $t$  for each box on the same axis by using two different colors and providing a key.

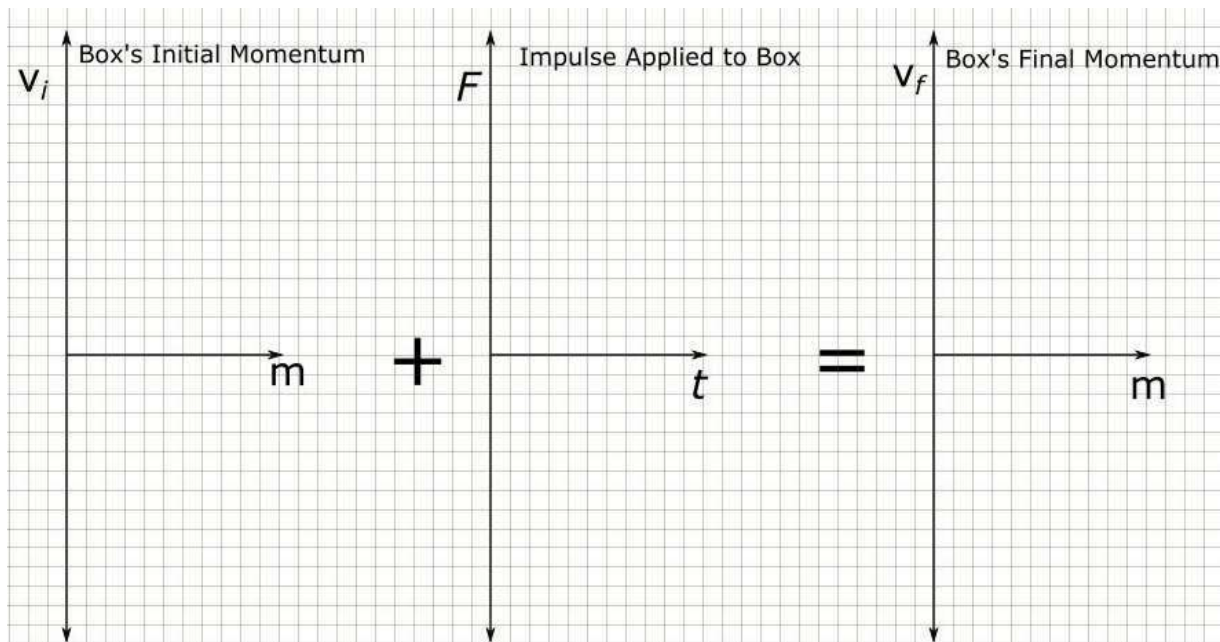
**Quantitative Analysis**

**PART D:** Using the equation for the area of a rectangle,  $A = bh$ , write two equations, one with words and one with units, for the area of the rectangle between the net external force vs. time line and the  $x$ -axis on the graph created in Part C.

The area under a net external force vs. time graph represents the \_\_\_\_\_. (Hint: Check units!)

## 5.B Impulse

**PART E:** Re-represent the data above by creating a momentum diagram for each box on the same set of axes by using two different colors and providing a key. (A momentum diagram represents the momentum of an object or system by showing the mass of the object as the width of bar on the chart, and the velocity of the object as the height of the bar.



### Argumentation

**PART F:** Is the work done on the first box while speeding up greater than, less than, or the same as the work done on the second box while speeding up?

\_\_\_\_\_ Greater than \_\_\_\_\_ Less than \_\_\_\_\_ Same

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**PART G:** Is the impulse given to the first box while speeding up greater than, less than, or the same as the impulse given to the second box while speeding up? Justify your ranking.

\_\_\_\_\_ Greater than \_\_\_\_\_ Less than \_\_\_\_\_ Same

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