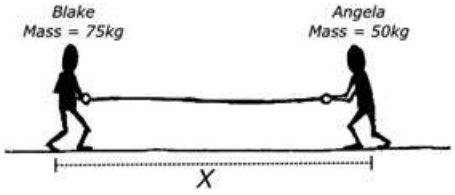
NAME _____ DATE _____

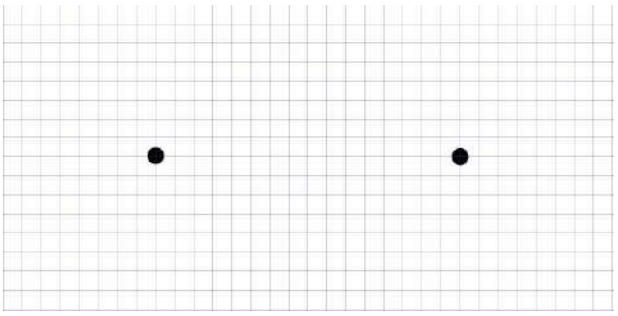
Scenario

Two students, Blake and Angela, stand on a smooth icy surface, a distance x apart and pull on opposite ends of a rope to pull themselves together. They each hold tightly onto the rope, which has negligible mass. Angela pulls on the rope with a constant force, so that she and Blake approach each other and meet. The system includes both students and the rope.



Using Representations

PART A: The dots to the right represent the two students. Draw free-body diagrams showing and labeling the forces (not components) exerted on each student. Draw the relative lengths of all vectors to reflect the relative magnitudes of all the forces.



Data Analysis

PART B: From the following four statements about the situation above, place a check mark next to the statement if it is completely true and provide justification. If it is partly true, correct the statement, and if it is false, cross out the statement and provide justification.

_____ A. Only Angela moves relative to the ice.

_____ B. The magnitude of Angela's acceleration is less than the magnitude of Blake's acceleration.

_____ C. Just before they meet, Blake's speed is less than Angela's speed.

_____ D. While the students are moving, their momentum vectors have equal magnitude and direction.

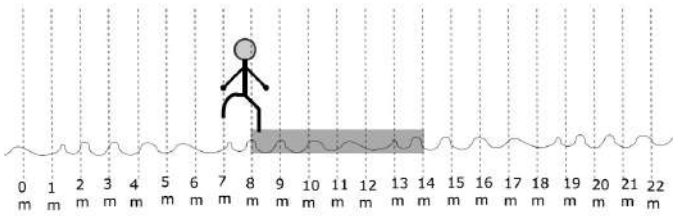
Argumentation

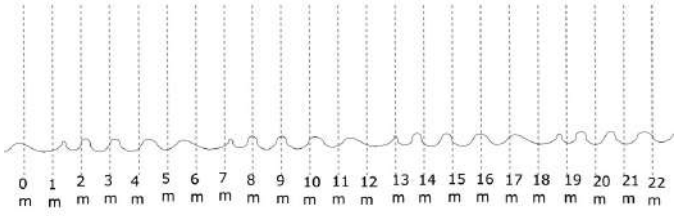
PART C: Where do the two students meet?

The students meet at the _____ of the system.

Justify your answer in a few short sentences. You do not need to do any calculations to determine where they meet.

PART D: Carlos ($m = 50$ kg) stands on the far-left edge of a 100 kg stand-up paddle board. The board is 6 m long as shown in the diagram below and slides across the surface of the water with negligible friction. On the diagram, show the location of the student-board center of mass. Then draw what the system will look like after Carlos walks to the other end of the board. On this second diagram, mark the location of the student-board center of mass.





Briefly explain how you made your second drawing. How did you know where to set the board? Give an explanation in terms of external forces and center-of-mass concepts.