UNIT
10 *Mechanical Waves and Sound* | 10.E Displacement of Wave vs. Displacement of Medium
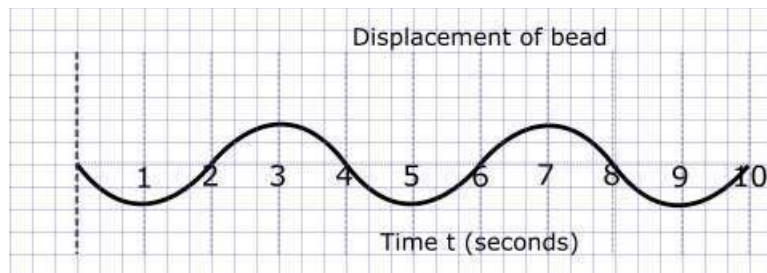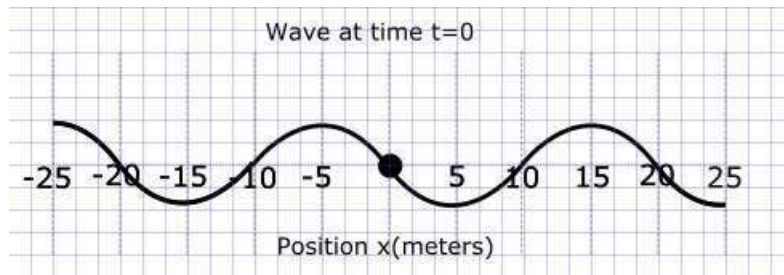
NAME _____   **DATE** _____

Scenario

A long elastic cord carries a traveling transverse wave with a bead fixed at position $x = 0$. The graph below left depicts the wave and the bead at time $t = 0$, a "snapshot." The graph below and to the right shows the displacement of the bead as a function of time.

Wave at time t=0

-25 -20 -15 -10 -5   5 10 15 20 25

Position x(meters)

Displacement of bead

1   2   3   4   5   6   7   8   9   10

Time t (seconds)

Data Analysis

PART A: Calculate the speed of waves on this cord. Explain how you use the graphs to obtain information that is used to make your calculation.

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PART B: State whether the wave is moving left or right. Explain how you used information from the graphs above to make this determination.
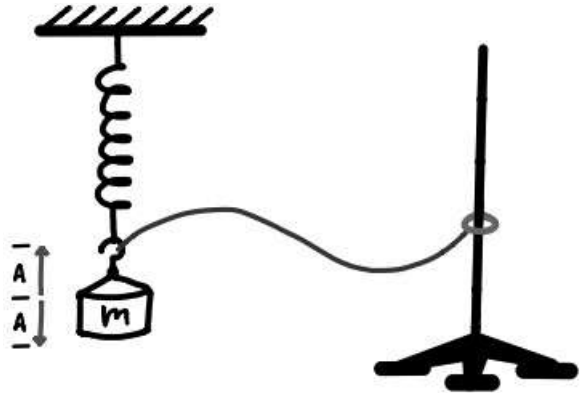
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Using Representations

PART C: The snapshot above is repeated below, but this time, eight positions on the string are marked. At the instant $t = 0$, sketch a velocity vector arrow for each of the marked positions, showing the instantaneous velocity for each of the eight parts of the string. If the velocity at a given position is zero, write "$v = 0$" at that location.

Wave at time t=0

Position x(meters)
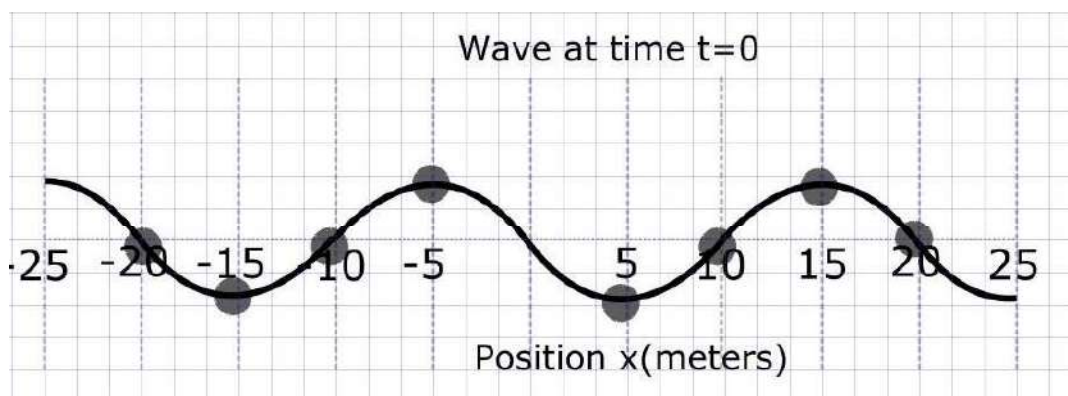
PART C: Suppose that the amplitude of the wave is 0.4 meters. What is the average speed of the bead as it moves? Explain.

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Argumentation

PART D: The waves occur because one end of the elastic cord is connected to a mass much heavier than the cord and that mass hangs vertically from a strong ideal spring. The mass oscillates on the spring, causing the waves on the elastic cord. Angela wishes to change the wave so that the peaks on the graph above right are closer together, but the graph above left is unchanged. Blake indicates that, to do this, the tension in the cord and the amount of mass on the spring must both be changed. State how the tension and mass must be changed in order to accomplish the changes Angela desires. Justify using physical principles and relationships.

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