Scenario
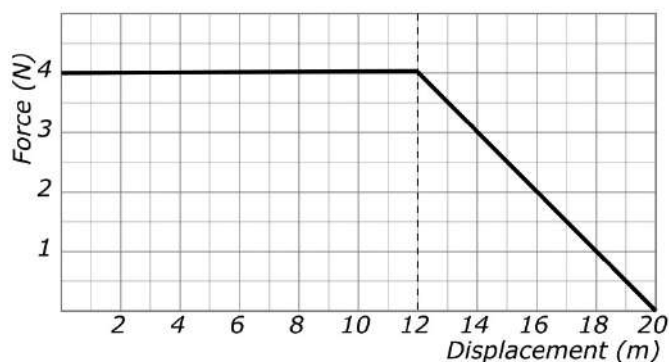
Starting from rest, a 1 kg cart moves to the right along a horizontal surface that exerts negligible friction, while being pushed by a horizontal force F *as shown. The force exerted on the cart as a function of displacement is graphed below.*

Data Analysis

PART A: **Claim:** The cart will have a change in mechanical energy of $48\ J$ as its displacement is changed by 12 m.

Collect evidence about the physical meaning of the area under the line on the graph that can be used to support the claim above. Write an equation (including units) for the area between the force line and the x-axis between $x = 0$ m and $x = 12$ m.

Evidence: The area under the line of the force vs. displacement graph is equal to

_____ _____ × _____ _____ = _____ _____. This area is also known as the
 number   units   number   units   number   units

_____ done on the object.
 physical quantity

Reasoning: Fill in the blanks of the following statement:

The claim makes sense because the _____ done on the cart is also equal to the change in

_____ of the cart.

PART B: Explain how the graph above could be used to determine the final speed of the cart after 12 m.

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Using Representations

PART C: On the grid to the right, sketch a graph of the acceleration of the cart as a function of displacement from $x = 0$ m to $x = 12$ m.

PART D: After creating her graph of acceleration vs. displacement, Angela says, "Oh, the slope of a velocity graph represents the acceleration. So, since the acceleration is constant at 4 m/s^2, the velocity should be a line with a slope of 4 m/s^2.
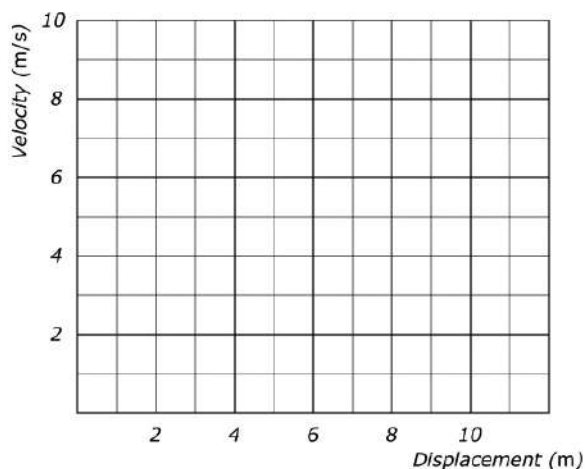
Do you agree with Angela?

_____ Yes   _____ No

Explain.

_____

_____

_____

_____
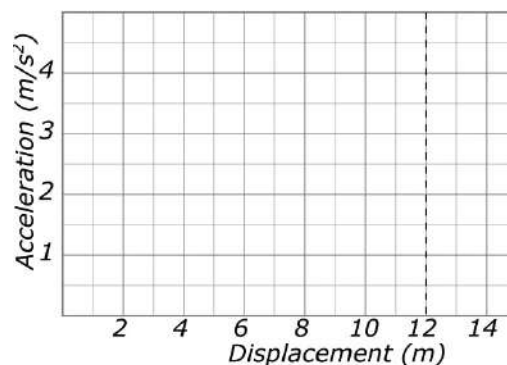
PART E: Sketch a graph of the velocity of the cart as a function of displacement.

Quantitative Analysis

PART F: The equation $v^2 = v_0^2 + 2a(\Delta x)$ can help describe the velocity of an object with a constant acceleration as a function of position. Is this equation consistent with the graph you sketched in Part E? Explain.

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