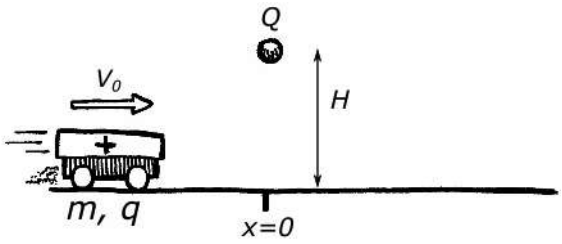
NAME _____ DATE _____

Scenario

A cart having a positive charge q *and mass* m *rolls on a track. Friction in the bearings may be neglected. The cart is initially to the left of position* $x = 0$ *and has a rightward velocity* v_0. *A fixed positive charge* Q *is located directly above position* $x = 0$, *a height* H *above the track. The cart itself is very small compared to the distance* H.

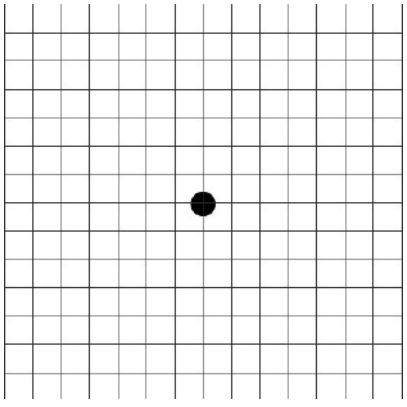


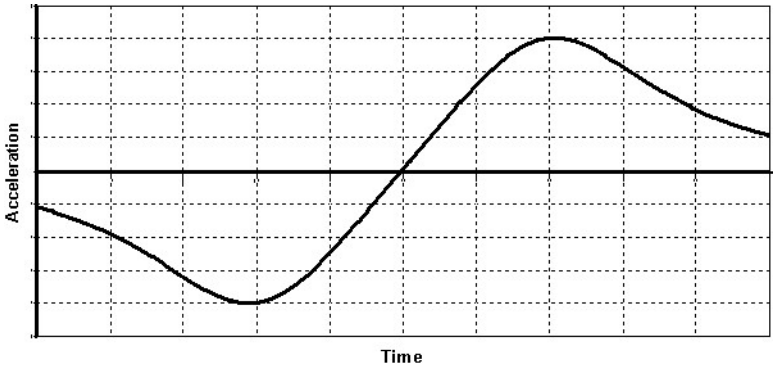
The graph of the acceleration of the cart (where the rightward direction is positive) is shown. The two other grids show three points on the graphs of the cart's velocity and position as functions of time.

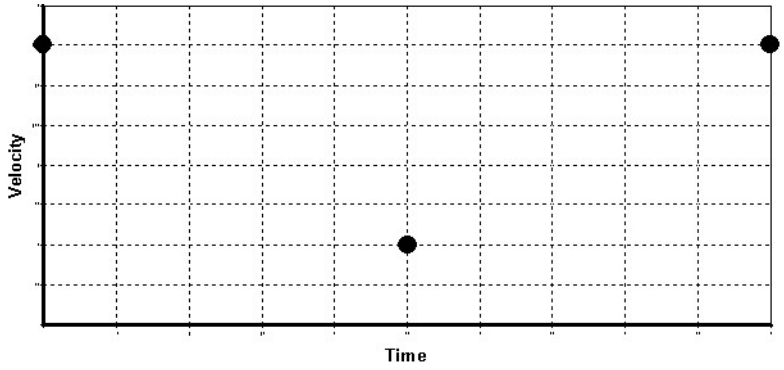
Using Representations

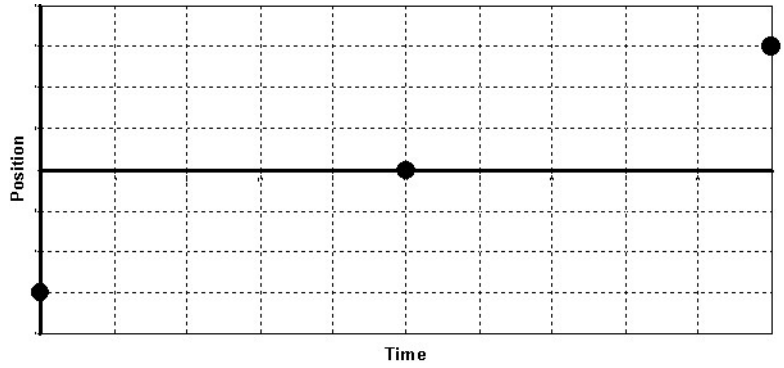
PART A: On the grids labeled "velocity" and "position," connect the three dots with appropriate lines or curves to make graphs of the cart's velocity and position as functions of time during the same interval shown in the acceleration vs. time graph.

PART B: The dot below represents the cart. Draw a free-body diagram showing and labeling all the forces (not components) exerted on the cart when the cart is located at position $x = -H$. Indicate relative lengths of the forces that balance.









Argumentation

PART C: The graph shows the magnitude of acceleration increasing as the cart approaches the origin, then decreasing to zero as the cart reaches the origin. In a clear, coherent, paragraph-length response, explain why the magnitude of acceleration increases and then decreases as the cart approaches the origin. Refer to the forces that you drew on Part B and/or their components as necessary.