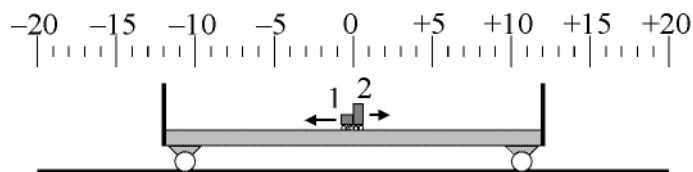


NAME \_\_\_\_\_ DATE \_\_\_\_\_

## Scenario

Two small carts, Cart 1 (mass  $m_1 = 5 \text{ kg}$ ) and Cart 2 (mass  $m_2 = 10 \text{ kg}$ ), are set in contact with each other at position  $x = 0$  on a larger platform. The platform is centered on position  $x = 0$  and is 24 meters long. The carts and platform can roll on bearings of negligible friction and are all initially at rest.



At time  $t = 0$ , a small spring between the two carts expands, sending Cart 1 to the left with an initial speed of  $4 \text{ m/s}$ . Both carts collide and bounce off the bumpers at the ends of the platform, which can be assumed to be perfectly elastic. When the carts collide with each other again, they stick together.

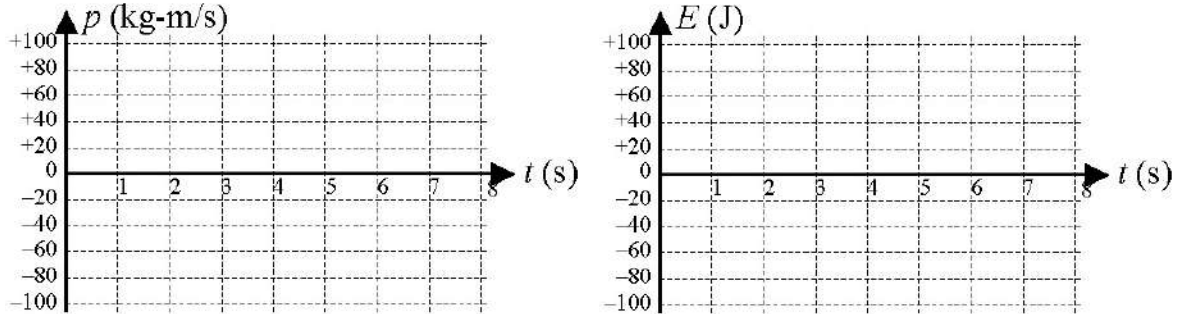
**PART A:** For this part, assume that the brakes on the platform's wheels are set so that the platform cannot move. The carts collide again at time  $t = 8$  seconds.

- i. Do the carts collide again at, to the left of, or to the right of  $x = 0$ ? After colliding, are the two carts moving left, moving right, or not moving? In a clear, coherent, paragraph-length response that explains the motions of the carts between times  $t = 0$  and  $t = 8$  s and includes specific calculations as needed, explain your reasoning.

[illegible]

## 11.J Momentum and Energy in Collisions

- ii. On the axes below, draw graphs of the total momentum  $p$  of the two-cart system (where positive momentum is rightward momentum) and the total mechanical energy  $E$  of the two-cart system (where the top of the platform is zero gravitational potential energy) as a function of time for the interval between  $t = 0$  and  $t = 8$  seconds.



**PART B:** Suppose that the platform's wheels are free to roll, but the platform has much more mass than the two carts. If the experiment is repeated again exactly as before, will the center of the platform be to the left, to the right, or at  $x = 0$  when the carts collide again and stick? Briefly explain your reasoning.

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