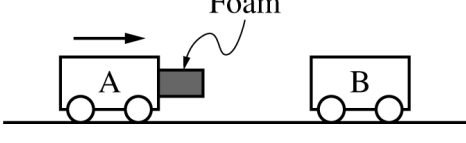


PHYSICS C: MECHANICS
SECTION II
Time—45 minutes
3 Questions

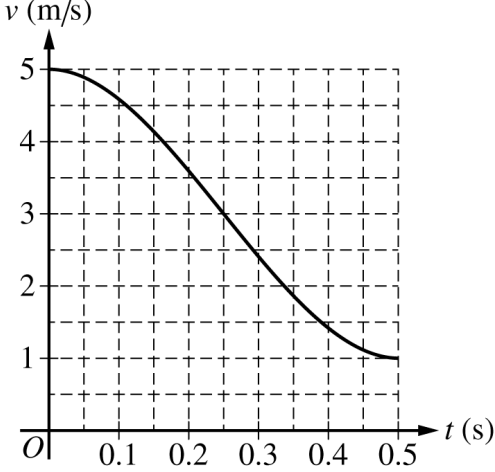
Directions: Answer all three questions. The suggested time is about 15 minutes for answering each of the questions, which are worth 15 points each. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part.



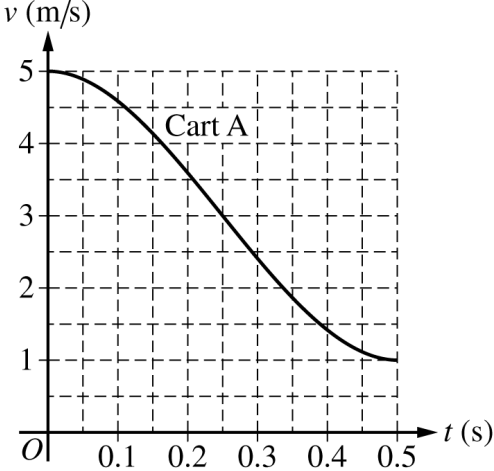
Scientists have created a new type of lightweight foam and are performing experiments to investigate the properties of the foam. The mass of Cart A is 1000 kg and the mass of Cart B is 2000 kg. A piece of foam with negligible mass is attached to the front of Cart A, as shown. Cart A moves with a constant speed toward Cart B, which is initially at rest. At time $t = 0$ s, the foam connected to Cart A makes contact with Cart B. The foam remains in contact with Cart B for 0.5 s, after which the carts separate and both carts move with constant velocities.

GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 1** on this page.



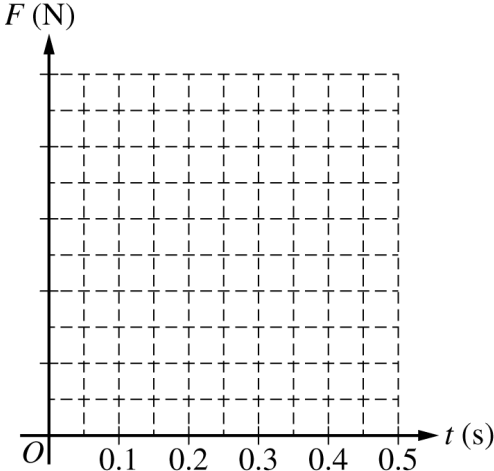
- (a) The graph shows the velocity v of Cart A as a function of time t for the time interval when the foam and Cart B are in contact.
- i. What feature(s) of the graph could be used to estimate the displacement of Cart A during the collision?
- ii. Using the information shown in the graph, determine the speed of Cart B at $t = 0.5$ s.
- iii. On the following grid, draw a smooth curve of the velocity of Cart B as a function of time.



GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 1** on this page.

- (b) For $0 \leq t \leq 0.50$ s, the velocity v of Cart A can be described by the function $v(t) = 64t^3 - 48t^2 + 5$.
- i. Calculate the magnitude of the maximum net force acting on Cart A during this interval.
- ii. On the following grid, draw a smooth curve of the magnitude of the force acting on Cart A as a function of time. Clearly indicate the value of the maximum force on the vertical axis.



GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 1** on this page.

The foam is removed from the front of Cart A and the experiment is repeated. The carts collide, with both Cart A and Cart B having the same initial and final velocities as in the original collision. The time intervals during which the carts are in contact are different in the collision with the foam and the collision without the foam. In the collision without the foam, Cart A is in contact with Cart B for a shorter duration than in the original collision, when the foam was present.

For the original collision when the foam is present, the magnitude of the average net force exerted on Cart B is F_1 . For the collision without the foam, the magnitude of the average net force exerted on Cart B is F_2 .

- (c) What is the relationship between the magnitude of the average net force F_1 exerted on Cart B for the collision with the foam and the magnitude of the average net force F_2 exerted on Cart B for the collision without the foam?

_____ $F_1 > F_2$ _____ $F_1 < F_2$ _____ $F_1 = F_2$

Justify your answer.

GO ON TO THE NEXT PAGE.