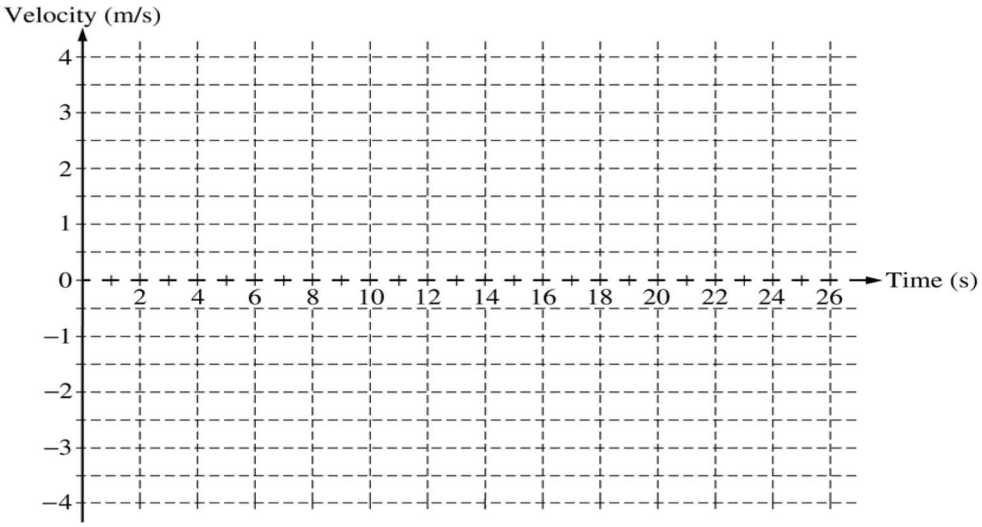
PHYSICS B
SECTION II
Time—90 minutes
7 Questions

Directions: Answer all seven questions, which are weighted according to the points indicated. The suggested time is about 11 minutes for answering each of questions 1-2 and 5-7, and about 17 minutes for answering each of questions 3-4. The parts within a question may not have equal weight. Show all your work in the pink booklet in the spaces provided after each part, NOT in this green insert.

1. (10 points)

The vertical position of an elevator as a function of time is shown above.

(a) On the grid below, graph the velocity of the elevator as a function of time.



(b)

i. Calculate the average acceleration for the time period $t = 8$ s to $t = 10$ s.

ii. On the box below that represents the elevator, draw a vector to represent the direction of this average acceleration.

(c) Suppose that there is a passenger of mass 70 kg in the elevator. Calculate the apparent weight of the passenger at time $t = 4$ s.

GO ON TO THE NEXT PAGE.

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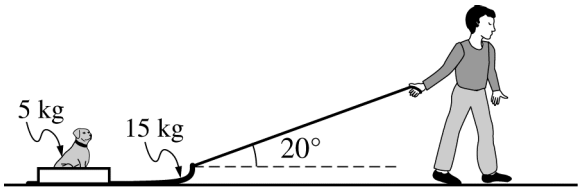
Directions: Answer all seven questions, which are weighted according to the points indicated. The suggested times are about 17 minutes for answering each of Questions 1 and 3 and about 11 minutes for answering each of Questions 2 and 4-7. The parts within a question may not have equal weight. Show all your work in the goldenrod booklet in the spaces provided after each part, NOT in this lavender insert.



1. (15 points)

A child pulls a 15 kg sled containing a 5.0 kg dog along a straight path on a horizontal surface. He exerts a force of 55 N on the sled at an angle of 20º above the horizontal, as shown in the figure above. The coefficient of friction between the sled and the surface is 0.22.

(a) On the dot below that represents the sled-dog system, draw and label a free-body diagram for the system as it is pulled along the surface.

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(b) Calculate the normal force of the surface on the system.

(c) Calculate the acceleration of the system.

(d) Calculate the work done by the child's pulling force as the system moves a distance of 7.0 m.

(e) At some later time, the dog rolls off the side of the sled. The child continues to pull with the same force. On the axes below, sketch a graph of speed v versus time t for the sled. Include both the sled's travel with and without the dog on the sled. Clearly indicate with the symbol t_r the time at which the dog rolls off.

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1. (10 points)

   A 70 kg woman and her 35 kg son are standing at rest on an ice rink, as shown above. They push against each other for a time of 0.60 s, causing them to glide apart. The speed of the woman immediately after they separate is $0.55\ \text{m/s}$. Assume that during the push, friction is negligible compared with the forces the people exert on each other.

   (a) Calculate the initial speed of the son after the push.

   (b) Calculate the magnitude of the average force exerted on the son by the mother during the push.

   (c) How do the magnitude and direction of the average force exerted on the mother by the son during the push compare with those of the average force exerted on the son by the mother? Justify your answer.

   (d) After the initial push, the friction that the ice exerts cannot be considered negligible, and the mother comes to rest after moving a distance of 7.0 m across the ice. If their coefficients of friction are the same, how far does the son move after the push?

GO ON TO THE NEXT PAGE.