CHAPTER 5 PRACTICE PASSAGE

Alice is playing with her little brother Jeff at an ice skating rink that is entirely flat except for a ramp at one end that is at an upward incline of 30 degrees. Alice is pushing Jeff on a little toboggan that has blades on the bottom, so it glides along the surface of the ice without the effects of friction. Alice has a mass of 60 kg, Jeff has a mass of 28 kg and the mass of the toboggan is 2 kg.

Alice is pushing Jeff around the rink and decides that she wants to push him right up until the incline, then let go and see how far up the incline he goes. They start from rest 10 meters from the incline and she pushes him with a force that varies with the distance (Figure 1). Jeff goes speeding up the incline with a velocity of 2 m/s, travels a certain distance and then comes speeding down. At the bottom of the incline, Jeff's toboggan collides with Alice and the two of them travel across the ice.

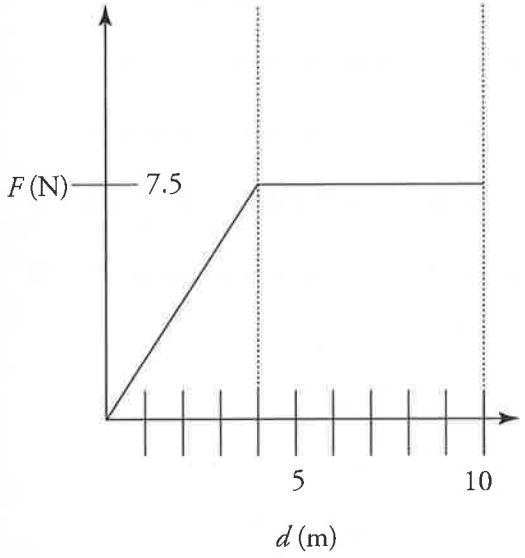

Figure 1 Graph of force vs. distance

Alice and Jeff keep sliding on the ice until the toboggan crashes into the end of the rink. One of the blades on the bottom of the toboggan has come loose in the crash and it no longer glides effortlessly on the ice. Alice once again pushes Jeff with a force given by Figure 1 and lets go just as they reach the incline. This time Jeff travels 10 centimeters less up the incline than he did before the toboggan broke.

1. How much work does Alice do from the moment she begins to push Jeff 10 m from the incline until she lets go just before the incline?

A) 60 J
B) 75 J
C) 0 J
D) There is not enough information to answer the question.

2. The first time Jeff goes up the incline, what distance along the incline does the toboggan travel before it comes to rest?

A) 0.2 m
B) 0.3 m
C) 0.4 m
D) 0.5 m

3. Assuming that the collision between Jeff and Alice at the bottom of the incline is perfectly inelastic, this tells us that:

I. kinetic energy is conserved.
II. momentum is conserved.
III. total velocity before and after the collision is the same.

A) I only
B) II only
C) I and II only
D) I, II, and III

4. Imagine that instead of Alice jumping on the toboggan during the collision, they "bounce" off of one another in a perfectly elastic collision and they both speed off in different directions. If Jeff speeds back up the incline with a velocity of 2/3 m/s, with what speed is Alice moving away from the incline?

A) 1/3 m/s
B) 2/3 m/s
C) 1 m/s
D) 4/3 m/s

5. Once the toboggan has broken, if Jeff goes up the incline with the same initial velocity v as he did the first time, how much energy has been lost?

A) 1.0 J
B) 1.5 J
C) 10 J
D) 15 J

6. If Alice did 10 J of work while pushing Jeff in 5 seconds, and the force of friction due to the broken toboggan did 2 J of work, how much power did Alice exert?

A) 50 W
B) 2 W
C) 1.6 W
D) 1.5 W

7. If Jeff brought his friend Jeremy out to play with him and Alice pushes both of them from rest on the toboggan with the same force as given in Figure 1, how would the distance they travel up the incline and their initial velocity change from when just Jeff was being pushed (ignoring friction)?

A) The velocity would be greater and they would go further.
B) The velocity would be greater and they would go less far.
C) The velocity would be less and they would go further.
D) The velocity would be less and they would go less far.