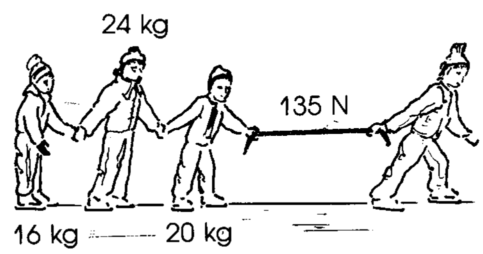
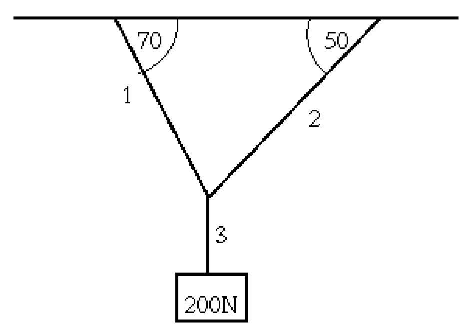
SPH4UI : Dynamics

Towing and Cabling Questions Part 1

1. Two girls, one of mass 40 kg and the other 60kg, are standing side by side in the middle of a frozen pond. One pushes the other with a force of 360N for 0.1s. The ice if essentially frictionless.
    a. What is each girl's acceleration?
    b. What velocity will each girl acquire in the 0.10s that the force is acting?
    c. How far will each girl move during the same time period?
2. A locomotive with a mass of 2.0×10^4 kg accelerates from rest to a velocity of 2.0m/s in 5.0s. If it is pulling a train of 20 cars, each with mass of 1.0×10^4 kg, what is the force in the coupling at each of the following points (you can assume frictional forces are zero in this problem)?
    a. Between the locomotive and the first car?
    b. Between the 10^{th} car and the 11^{th} car?
3. Three small children of mass 20.0kg, 24.0kg and 16.0kg respectively, hold hands, as shown, and are pulled across a smooth frozen pond by a larger boy on skates, who pulls a horizontal rope being held by the first child. The skater pulls on the rope with a force of 135N. Calculate each of the following:
    a. The acceleration of the skater
    b. The force with which each pair of children must hold hands, to ensure the chain is not broken.



4. A 200 Newton block is suspended by 3 cables as shown to the right. Find the tension in each cable.

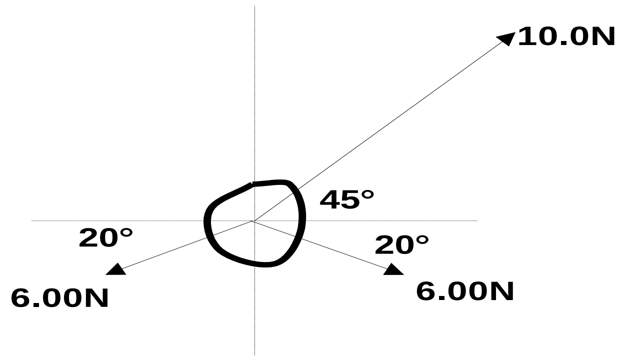


Answers :

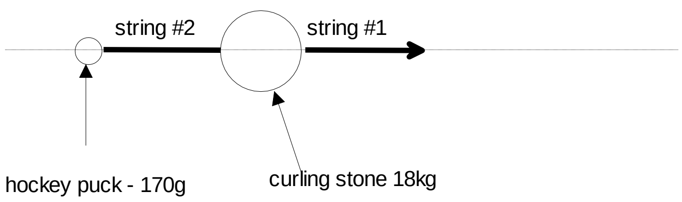
1. a. $9.0\ m/s^2$, $-6.0 m/s^2$
   b. 0.90 m/s, -0.60m/s
   c. 0.045m, -0.03m
2. a. 8.0×10^4N
   b. 4.0×10^4N
3. a. $2.25 m/s^2$
   b. 90N, 36N
4. T_3=200N, T_2=79N, T_1=148N

Towing and Cabling Questions Part 2

1. Three forces all act on a 10.0 kg mass at the same time as shown to the right. Assuming these are the only forces acting on the mass, what is the acceleration of the mass?



2. As shown below a curling stone and a hockey puck are tied together and pulled by another string with an acceleration of 3.0m/s². Assuming the ice is frictionless; calculate the tension in each of the two strings.



3. A man is standing in an elevator with a bag of gold that has a mass of 5 kg (worth about $250,000). Coincidentally he also has a an accurate scale with him and he notices that the initial reading on the scale is 5.00kg before the elevator starts moving, but as the elevator starts to move he is pleasantly surprised to see that the scale reads 5.10 kg (an increase of almost $5,000). You have been hired to explain to this man why he doesn't magically have more gold and therefore why he isn't richer.

a. What acceleration would the elevator have to have to explain this difference in apparent weight?

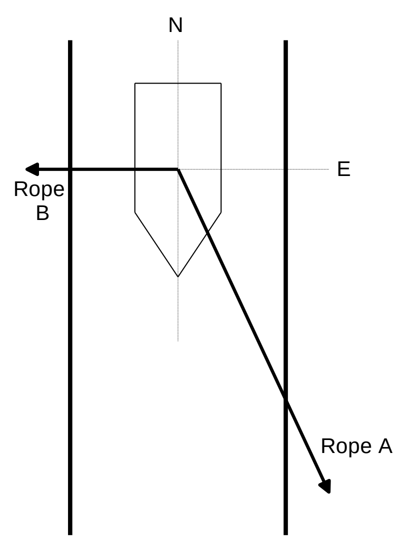
b. Is the elevator accelerating upwards or downwards?

c. If the elevator was moving downwards, explain how this effect could be achieved (remember the acceleration and velocity do not always have to be in the same direction).

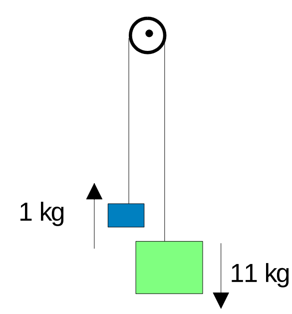
4. An 850kg boat is being pulled through a straight canal by two towing ropes. Rope A is pulling with a force of 623N [S35°E] as shown in the diagram. Rope B is pulling 90° due west as shown. The force of friction due to the water (in the direction of motion) is 350N.

a. Calculate the force that Rope B has to pull with so that the boat will go straight down the canal.

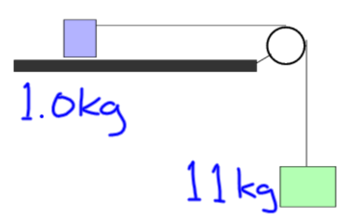
b. What acceleration does the boat have when both ropes are pulling?



5. An vertical Atwood machine has a 1.0kg and a 11kg mass attached to either end of a string (assume the pulley is frictionless and has zero mass). What is the tension in the string and overall acceleration of the system?



6. The same two masses (1.0kg and 11kg) are now on a horizontal surface as shown to the right. If the coefficient of kinetic friction between the 1.0kg object and the horizontal surface is 0.15, what is the tension in the rope and overall acceleration of the system?



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1. a= 0.767 m/s² [right23°up] 2. F_{T1}= 54.5N F_{T2}= 0.51N 3a. a= 0.196m/s² b. upwards

4a. F_{TB}= 357N b. a=0.19m/s² 5. F_T= 18N a=8.2m/s² 6. F_T=10N (1.0x10¹N) a=8.9m/s²