PHYS UN1601 Recitation Worksheet 5

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October 9, 2024

Problem 1

In the Atwood's machine shown in Figure 1, the pulleys and strings are massless. Explain why:

a) The tension is the same throughout the long string, as indicated

b) The tension in the bottom string is twice the tension in the long string, as indicated

c) The acceleration of the right mass is negative twice the acceleration of the left mass.

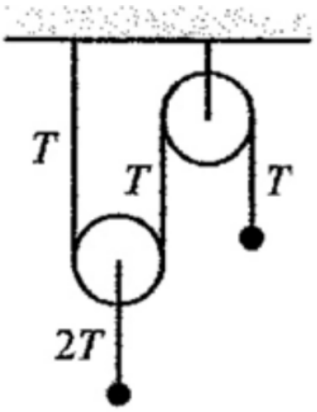
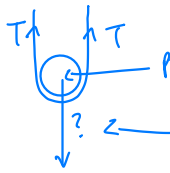


Figure 1

a) assume tension is not constant ⇒ then there must be a part of the string where tension is different at two ends, so there must be a net force on this part of the string. but string is massless and $F=ma$, so a must be infinite, which is unphysical. hence tension must be the same

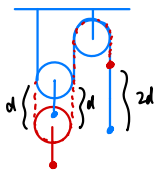
b)



pulley is massless, so net force must be 0

hence bottom string must have tension = $2T$

c)



if (left mass (and so left pulley) moves down by d, right mass moves up by $2d$

$\Rightarrow d_2 = -2d_1$

$\frac{d}{dt}(d_2 = -2d_1) = v_2 = -2v_1 \Rightarrow a_2 = -2a_1$

Problem 2

A 45° wedge is pushed along a table with constant acceleration a. A block of mass m slides without friction down the wedge. Find its acceleration.

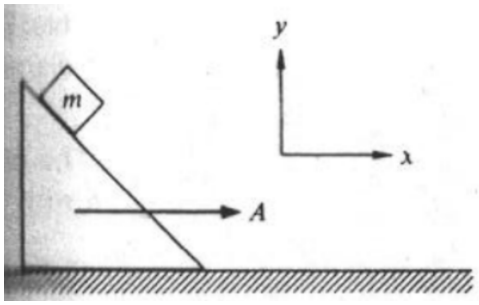
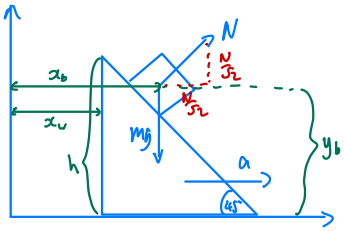


Figure 2



we know $\frac{x_b - x_w}{h - y_b} = \tan(45°) = 1$

$\Rightarrow x_b - x_w = h - y_b$

$\ddot{x}_b - a = -\ddot{y}_b$

now consider forces in x-dir: $m\ddot{x}_b = \frac{N}{\sqrt{2}} = \frac{m}{\sqrt{2}}g + \frac{m}{\sqrt{2}}\ddot{y}_b$

y-dir: $m\ddot{y}_b = \frac{N}{\sqrt{2}} - mg$

$\Rightarrow \ddot{x}_b = g - \ddot{x}_b + a \Rightarrow \ddot{x}_b = \frac{g+a}{2}$, $\ddot{y}_b = \frac{a-g}{2}$