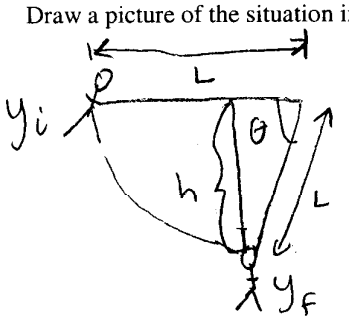
Group Problem

Your friend is going to play Tarzan in a school play. In one scene, he will stand at the top of a large platform (made to look like a tree) and grab a vine which is attached to a point located directly across from him horizontally. He will then step off the platform and swing down to the stage below. Your friend has a weight of 890 N, and the vine can support a tension of 1780 N. Because you have taken physics, you realize that the vine might not be strong enough for this to work. In fact, you sit down and calculate the exact angle below the horizontal direction in which the vine will break.

Context-Rich Problems: Solutions Outline

FOCUS the PROBLEM

Draw a picture of the situation including ALL the information given in the problem.



$W_F = 890N$

$T_{max} = 1780N$

note that

$h = L\sin\theta$

Question(s): What is the problem asking you to find?

What angle will the tension be greater than T_{max}?

Approach: Outline the approach you will use.

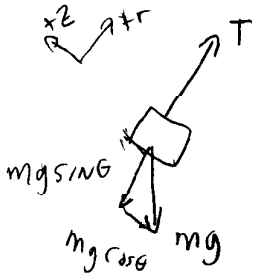
Use Newton's Second Law to Find Tension and Conservation of Energy to Find velocity at a certain height. Then height will give the angle

DESCRIBE the PHYSICS

Draw physics diagram(s) and define ALL quantities uniquely.

(Mechanical energy is conserved, so draw a before and after situation for energy conservation as we did in class.)

2nd Law



Energy

Before

$y_i = 0$

$m = \frac{890N}{g}$

$V_i = 0$

After

$y_f = -L\sin\theta$

$V_f = ?$

Which of your defined quantities is your Target variable(s)?

$\boxed{\theta}$

Quantitative Relationships: Write equations you will use to solve this problem.

$\Sigma \vec{F} = m\vec{a}$

$W_{ext}^{\nearrow 0} = \Delta K + \Delta U + \Delta E_{int}^{\nearrow 0}$

$K_i + U_i = K_f + U_f$

$a_c = \frac{v^2}{R}$

PLAN the SOLUTION

Construct Specific Equations (Same Number as Unknowns)

$y_f = -L\sin\theta$ (1) $\boxed{y_f, L, \theta}$

Find y_f

$U_i + K_i = U_f + K_f$

$0 + 0 = mgy_f + \frac{1}{2}mv_f^2$

$y_f = -\frac{v_f^2}{2g}$ (2) $\boxed{v_f}$

Find v_E

$\Sigma F_r = ma_c$

$T_{max} - mg\sin\theta = \frac{mv_f^2}{L}$

$v_f^2 = \frac{LT_{max}}{m} - Lg\sin\theta$ (3)

L may cancel, plug (3) into (1)

$y_f = -\frac{L}{2g}\left(\frac{T_{max}}{m} - g\sin\theta\right)$ (4)

Plug (4) into (1)

$-L\sin\theta = -\frac{LT_{max}}{2mg} + \frac{L\sin\theta}{2}$

$\sin\theta + 2\sin\theta = \frac{T_{max}}{mg}$

$\theta = \sin^{-1}\left(\frac{1}{3}\frac{T_{max}}{mg}\right)$

Check Units

$\frac{[F]}{[M]\frac{[L]}{[S]^2}} = \frac{[F]}{[F]} =$ No units in sin

EXECUTE the PLAN

Calculate Target Quantity(ies)

$\theta = \sin^{-1}\left(\frac{1}{3}\frac{1780}{890}\right)$

$= 42^\circ$

EVALUATE the ANSWER

Is Answer Properly Stated?

Yes, in degrees

Is Answer Unreasonable?

No, between 0 and 90°

Is Answer Complete?

Yes

(extra space if needed)

Write your Group Number here and the names of the group members who are present.

Group Number:_____

Name: Key

Name:_____

Name:_____

Name:_____