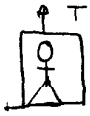
Context-Rich Problems: Solutions Outline

FOCUS the PROBLEM

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

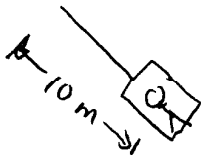
Two situations

① Hanging



890N + 45N chair

② rotating



220N + 45N chair

rotates once per 3.0 seconds

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

Has the operator shown the chair is safe?

Approach: Outline the approach you will use.

① Use Newton's Second law in both cases to calculate tension

② Compare the tensions

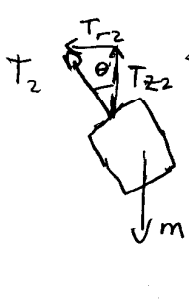
③ In case ② use centripetal acceleration

DESCRIBE the PHYSICS

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

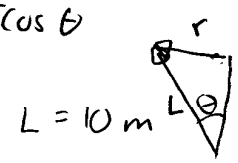
① Hanging

② Rotating



$T_{r2} = T \sin\theta$

$T_{z2} = T\cos\theta$



$L = 10\ m$

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

T_1 T_2

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

$\Sigma \vec{F} = m\vec{a}$ $\quad a_c = \frac{v^2}{r}$ $\quad v_T = \frac{2\pi r}{T}$ (period) $\quad T = \frac{1}{f}$

PLAN the SOLUTION
Construct Specific Equations (Same Number as Unknowns)

$\Sigma F_y = 0$

① $\boxed{T_1 = m_1 g}$

Unknowns

$\boxed{T_1}$

$\Sigma F_r = m_2 a_c$

$T_{r2} = \frac{m_2 V^2}{r}$

② $T_2 \sin\theta = \frac{m_2 V^2}{r}$

$\boxed{T_2, \theta, V, r}$

$\frac{r}{L} = \sin\theta$

③ $r = L\sin\theta$

④ $V = \frac{2\pi r}{T} = 2\pi r f = 2\pi f L \sin\theta$

Plug ③ and ④ into ②

$T_2 \sin\theta = \frac{m_2 4\pi^2 f^2 L^2 \sin^2\theta}{L\sin\theta}$

$T_2 = 4\pi^2 m_2 f^2 L$

⑤ $\boxed{T_2 = \frac{4\pi^2 W_2 f^2 L}{g}}$

Check Units

Eq ① $\frac{[m][L]}{[T]^2} = [N]$ ok

Eq ② $\frac{[N][L]}{[T]^2 \frac{[L]}{[T]^2}} = [N]$ ok

EXECUTE the PLAN
Calculate Target Quantity(ies)

$T_1 = 935\ N$

$T_2 = \frac{4\pi^2 (265N)\left(\frac{1rev}{3sec}\right)^2 (10m)}{(9.8\ m/s^2)}$

$= 1190\ N$

EVALUATE the ANSWER
Is Answer Properly Stated?

Yes, in Newtons

Is Answer Unreasonable?

No, both about the same, the weight of the operator

Is Answer Complete?

No, the operator has not shown the ride is safe while swinging, the 50 lb child exerts more force than the 200 lb man when stationary.

(extra space if needed)