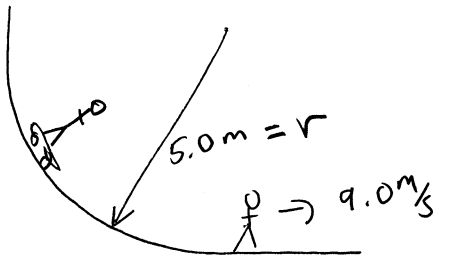
Context-Rich Problems: Solutions Outline

FOCUS the PROBLEM

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



m = 75 kg

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

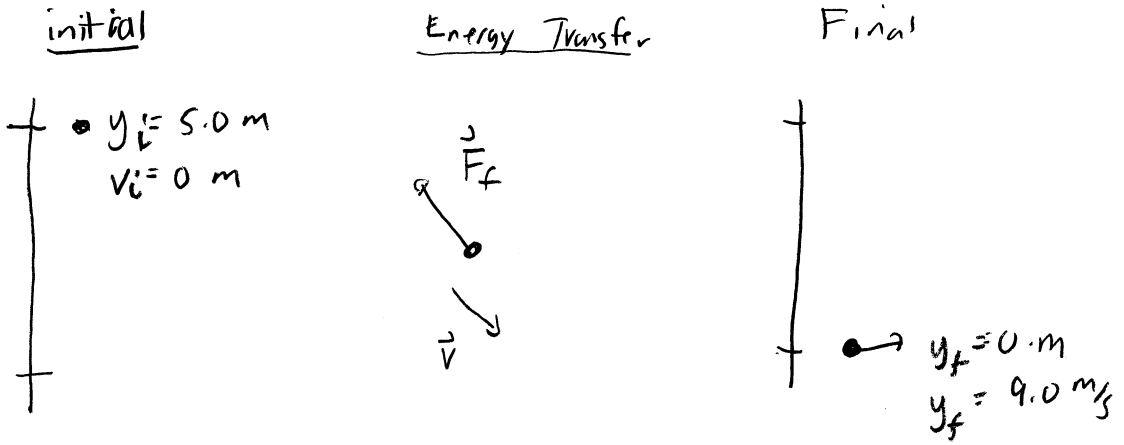
What is the work done by friction and average frictional force

Approach: Outline the approach you will use.

Use conservation of energy with work done by friction as the only non-conservative external work

DESCRIBE the PHYSICS

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



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

W_f, F_f

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

$W = \int \vec{F} \cdot d\vec{r}$

$K = \frac{1}{2}mv^2$

$W_{ext} = \Delta K + \Delta U$

$U_g = mgh$

PLAN the SOLUTION

Construct Specific Equations (Same Number as Unknowns)

Find $\langle F_f \rangle$

$W_f = \int \vec{F}_f \cdot d\vec{r} = \langle F_f \rangle \Delta r \cos\theta$

since $\theta = -1$, $\Delta r = \frac{1}{4} 2\pi r$

$W_f = -\langle F_f \rangle \frac{1}{2}\pi r$

$\langle F_f \rangle = -2W_f/\pi r$ (1)

Find W_f

$W_f = \Delta K + \Delta U = K_f - K_i + U_f - U_i$

$W_f = \frac{1}{2} m v_f^2 - mg y_i$ (2)

EXECUTE the PLAN

Calculate Target Quantity(ies)

(2) $W = \frac{1}{2}(75\,kg)(9.0\,m/s)^2 - (75\,kg)(9.8\,m/s^2)(5.0\,m)$

$= \boxed{-640\,J}$

(1) $\langle F_f \rangle = \frac{(2)(640\,J)}{\pi(5.0\,m)} = \boxed{81\,N}$

EVALUATE the ANSWER

Is Answer Properly Stated?

Yes, in Joules and Newtons

Is Answer Unreasonable?

This is a Force of about 18 pounds so it seems reasonable

Is Answer Complete?

Yes

(extra space if needed)

Check Units

For (2) $\frac{[m][L]^2}{[T]^2} - \frac{[m][L][T]}{[T]^2} = J$ ok

For (1) $\frac{[m][L]^2}{[T]^2[L]} = \frac{[m][L]}{[T]^2} = J$ ok