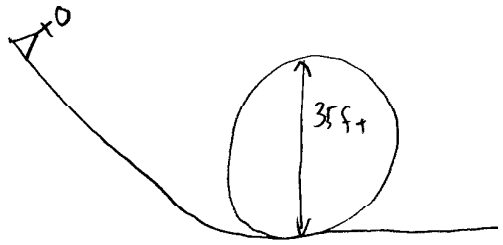
Context-Rich Problems: Solutions Outline

FOCUS the PROBLEM

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



$r = 17.5\,ft\left(\frac{12\,in}{ft}\right)\left(\frac{2.54\,cm}{in}\right)\left(\frac{1\,m}{100\,cm}\right) = 5.33\,m$

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

How high should the skater start to just follow the circular ramp?

Approach: Outline the approach you will use.

Use conservation of Energy between the top of the ramp and the top of the circle to determine velocity

Get minimum velocity from Newton's 2nd law and centripetal acceleration

DESCRIBE the PHYSICS

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

Energy diagram from top of ramp to top of circle

Before

$y_i = ?$

$v = 0$

Energy Transfer

None

After

$y_f = 10.66\,m = 2r$

$v_f = ?$

At top of circle

Free body diagram

mg

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

y_i

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

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

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

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

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

$U_g = mgy$

PLAN the SOLUTION

Construct Specific Equations (Same Number as Unknowns)

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

$K_i^{0} + U_{Gi} + U_{Ei}^{0} = K_f + U_{Gf} + U_{Ef}^{0}$

$mgy_i = \frac{1}{2}mv_f^2 + mgy_f$ $\boxed{y_i, v_f}$

$gy_i = \frac{1}{2}v_f^2 + gy_f$

$y_i = \frac{v_f^2}{2g} + y_f$ ①

Solve for v_f using Newton's 2nd law

$\Sigma F = ma$

$mg = \frac{mv_f^2}{r}$

$v_f^2 = gr$ ②

Plug ② into ①

$y_i = \frac{gr}{2g} + y_f$

$y_i = \frac{r}{2} + y_f = \frac{r}{2} + 2r$

$= \frac{5}{2}r$

Check Units

(L)

EXECUTE the PLAN

Calculate Target Quantity(ies)

$y_i = \frac{5}{2}(5.33m)$

$= 13.3m = 44ft$

EVALUATE the ANSWER

Is Answer Properly Stated?

Yes

Is Answer Unreasonable?

No, Larger than the radius

Is Answer Complete?

Yes

(extra space if needed)