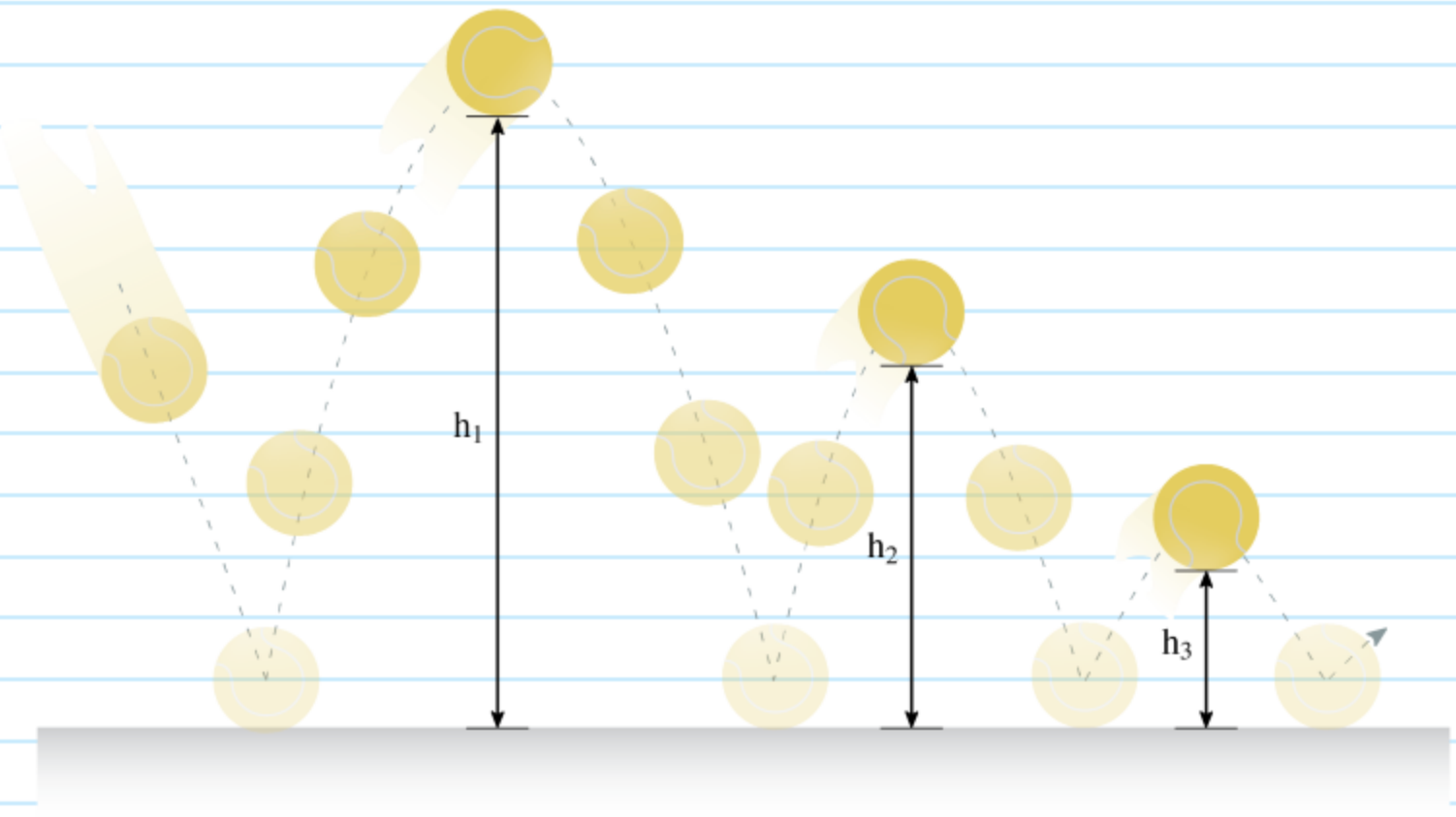
21-P-MOM-GD-005



A tennis ball is dropped from some initial height and bounces up to h_1 m, the ball bounces again up to h_2 m and finally it bounces one more time to a height of h_3 m. If the coefficient of restitution between the ball and the ground is e, what are h_2 and h_3?

given h_1, e

find h_2, h_3

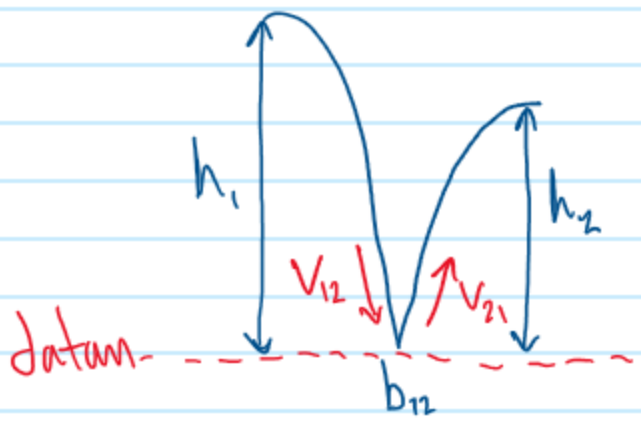
First Bounce ($h_1 \rightarrow h_{12} \rightarrow h_2$)

Cons. of Energy (right before impact)

$T_1 + V_1 = T_{12} + V_{12}$

$mgh_1 = \frac{1}{2}mv_{12}^2$

$v_{12} = \sqrt{2gh_1}$



Impact (g = ground)

$e = \frac{v_{21} - v_{g_2}}{v_{g_1} - v_{12}}$

$v_{21} = -ev_{12}$

Cons. of Energy (right after impact)

$T_{21} + V_{21} = T_2 + V_2$

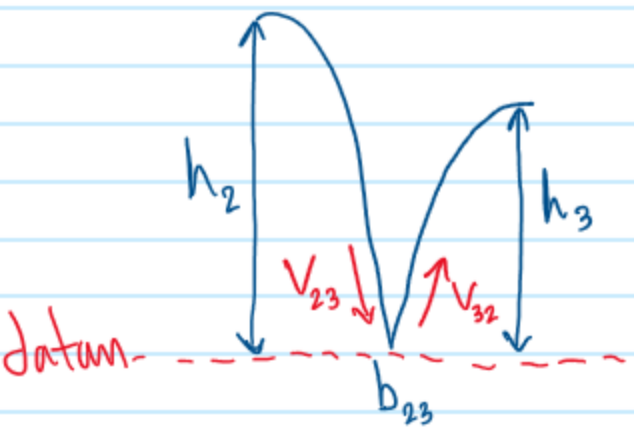
$\frac{1}{2}mv_{21}^2 = mgh_1$

$h_2 = \frac{v_{21}^2}{2g}$

Second Bounce ($h_2 \rightarrow h_{23} \rightarrow h_3$)

Cons. of Energy (right before impact)

$v_{21} = -v_{23} = \sqrt{2gh_2}$



Impact (g = ground)

$e = \frac{v_{32} - v_{g_2}}{v_{g_1} - v_{23}}$

$v_{32} = -ev_{23}$

Cons. of Energy (right after impact)

$T_{32} + V_{32} = T_3 + V_3$

$\frac{1}{2}mv_{32}^2 = mgh_3$

$h_3 = \frac{v_{32}^2}{2g}$