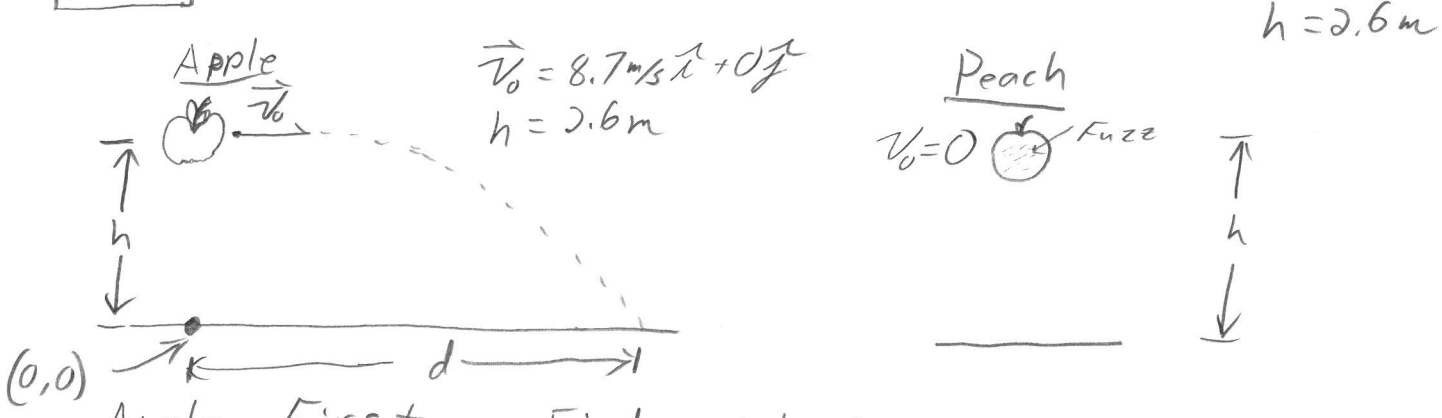
Physics 111
Homework

3-39



Apple First - Find total Flight time.

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \tfrac{1}{2}\vec{a}t^2 \qquad \vec{v} = \vec{v}_0 + \vec{a}t$$

x: $x = x_0 + v_{0x}t + \tfrac{1}{2}a_x t^2$ $\qquad v_x = v_{0x} \Rightarrow$ Boring ...

$$d = 0 + v_{0x}t$$

can't get t from here ... But if I knew it I could get d ...

y: $y = y_0 + \cancel{v_{0y}^{0}t} + \tfrac{1}{2}a_y t^2$ $\qquad v_y = v_{0y} + a_y t$

$$0 = h - \tfrac{1}{2}gt^2$$

Oh! I can get t From here.

$$\boxed{t = \left(\frac{2h}{g}\right)^{1/2}}$$

continued ↓

3-39 continued

Now the peach. It has only y velocities, nothing in x.

$$y = y_0 + \cancel{v_{0y}t}^{0} + \tfrac{1}{2}a_y t^2$$

$$0 = h - \tfrac{1}{2}gt^2 \quad \text{hmm...}$$

$$t = \left(\frac{2h}{g}\right)^{1/2} \quad \text{same as the apple!}$$

3-61

Given

$v_{oy} = 0$

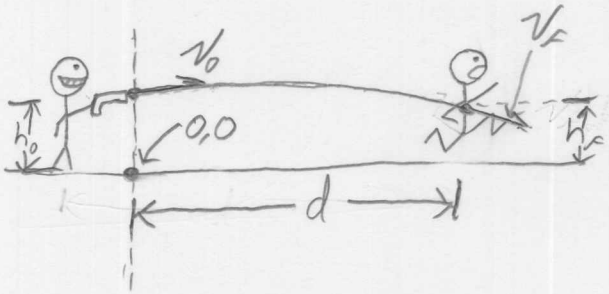
$h_o = 1.6\,m$

$h_f = 0.93\,m$

$d = 2.1\,m$

WANT

$v_{ox} = ?$



Trajectory Problem, 2D

x

$$x_f = x_o + v_{ox}t + \tfrac{1}{2}a_x t^2$$

$$d = 0 + v_{ox}t + 0$$

$$t = \frac{d}{v_{ox}}$$

y

$$y_f = y_o + v_{oy}t + \tfrac{1}{2}a_y t^2$$

$$h_f = h_o + 0 - \tfrac{1}{2}g t^2$$

$$h_f - h_o = -\frac{1}{2}g\frac{v_{ox}^2}{d^2}$$

$$v_{ox}^2 = \frac{-2(h_f - h_o)d^2}{g}$$

$$\boxed{v_{ox} = \left[\frac{2(h_o - h_f)d^2}{g}\right]^{1/2}}$$

$$v_{ox} = \left[\frac{2(1.6-0.93)(2.1)^2}{9.8}\right]^{1/2} = \boxed{0.78\ m/s}$$

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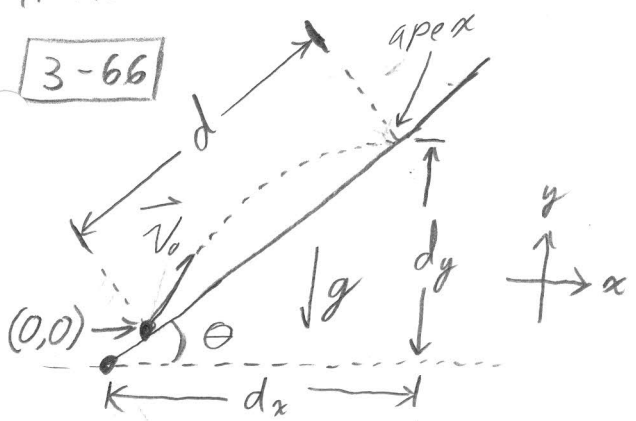
3-66



$d = 8.6\,m$

$\theta = 39°$

$v_{0x} = ?$, $v_{0y} = ?$

at apex: $v_y = 0$!

Kinematics equations in 2-D:

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \tfrac{1}{2}\vec{a}t^2 \qquad \vec{v} = \vec{v}_0 + \vec{a}t$$

Separate and solve:

x: $x = \cancel{x_0}^{\,0} + v_{0x}t + \cancel{\tfrac{1}{2}a_x t^2}^{\,0}$ $\qquad v_x = v_{0x} + \cancel{a_x t}^{\,0}$

$d_x = v_{0x}t$ $\qquad v_x = v_{0x} \Rightarrow$ Boring...

$\Rightarrow v_{0x} = \dfrac{d_x}{t}$, But $d_x = d\cos\theta$

① $\boxed{v_{0x} = \dfrac{d\cos\theta}{t}}$ need t

y: $y = y_0 + v_{0y}t + \tfrac{1}{2}a_y t^2$ $\qquad v_y = v_{0y} + a_y t$

② $\boxed{d_y = 0 + v_{0y}t - \tfrac{1}{2}gt^2}$ $\qquad 0 = v_{0y} - gt$

$\Rightarrow \boxed{v_{0y} = gt}$ ③

continued ↓

I have 3 equations and 3 unknowns.

I need t, so I'll eliminate v_{oy} from eq. ②

By substituting eq. ③

From ②: $d_y = v_{oy}t - \frac{1}{2}gt^2$

$= gt^2 - \frac{1}{2}gt^2$

$d_y = \frac{1}{2}gt^2 \Rightarrow \boxed{t = \left(\frac{2d_y}{g}\right)^{1/2}}$ ④

Now plug t from eq ④ back into ① and ③

From ①: $v_{ox} = \frac{d\cos\theta}{t} = d\cos\theta\left(\frac{2d_y}{g}\right)^{1/2}$

Oh but $d_y = d\sin\theta$

So: $\boxed{v_{ox} = d\cos\theta\left(\frac{2d\sin\theta}{g}\right)^{1/2}}$

$v_{ox} = (8.6)\cos(39)\left(\frac{(2)(8.6)\sin(39)}{9.8}\right)^{1/2}$

$\boxed{v_{ox} = 7\ m/s}$ *

From ③: $v_{oy} = gt = g\left(\frac{2d\sin\theta}{g}\right)^{1/2} = (2dg\sin\theta)^{1/2}$

$v_{oy} = \left((2)(8.6)(9.8)\sin(39)\right)^{1/2}$

$\boxed{v_{oy} = 10.3\ m/s}$