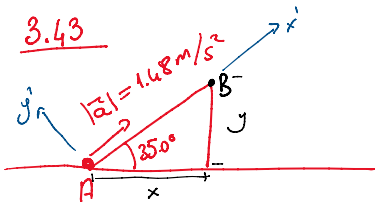
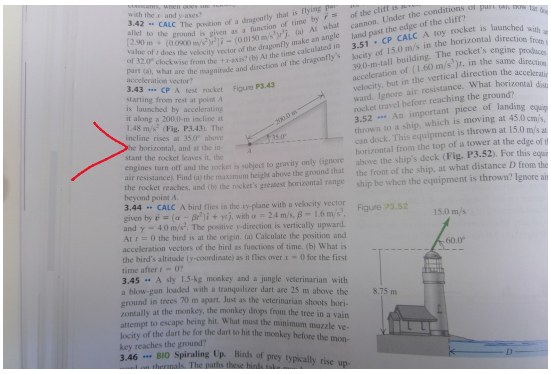
Lecture 6

9 Ekim 2019 Çarşamba 11:00

> Some problems

3.43





a) Maximum height?

b) Range from point A?

$\Rightarrow$ 1.) Find coordinates of B $\rightarrow$ $\cos 350 = \frac{x}{200.0m}$ $\quad x = 163.8\,m$

$\sin 35.0 = \frac{y}{200.0m}$ $\quad y = 114.7m$

2.) Find $\vec{v}$ at B

$|\vec{v}|^2 = 2\,|\vec{a}|\,(200.0m) = (24.3\ m/s)^2$ ($|\vec{a}| = 1.48\ m/s^2$)

$|\vec{v}| = 24.3\ m/s$

$V_x = 24.3\ m/s \cdot \cos 35.0 = 19.9\ m/s$

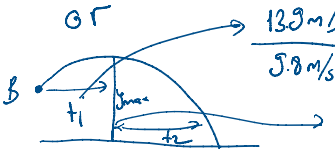
$V_y = 24.3\ m/s \cdot \sin 35.0 = 13.9\ m/s$

$y_{max} \rightarrow V_y(t) = 0 \Rightarrow -(13.9\ m/s)^2 = -2\,9.8\ m/s^2 \cdot (y_{max} - 114.7m)$

$v^2 = v_0^2 + 2a(y - y_0)$ ($\uparrow$ v, $\downarrow$ g)

$\boxed{y_{max} = 124.6\,m}$

time of flight? $\quad y(t) = 0 = 114.7m + 13.9\ m/s \cdot t - \frac{1}{2}\,9.8\ m/s^2\,t^2$



or $\quad \frac{13.9\ m/s}{9.8\ m/s^2} = 1.42\,s = t_1$

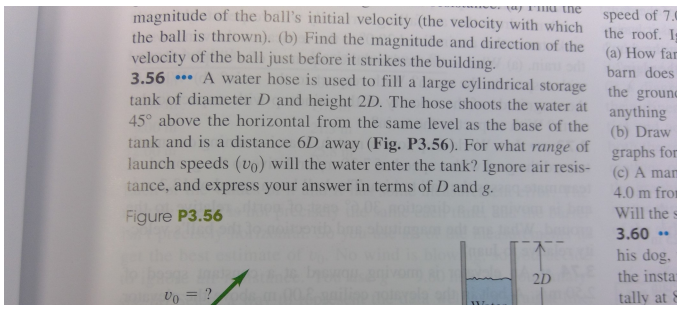
$0 = 124.6m - \frac{1}{2}\,9.8\ m/s^2\,t_2^2$

$t_2 = 5.04\,s$

$t_{tot} = 6.46\,s$

$\boxed{Range = 163.8m + 19.9\ m/s \cdot 6.46s = 291.2\,m}$

3.56



magnitude of the ball's initial velocity (the velocity with which the ball is thrown). (b) Find the magnitude and direction of the velocity of the ball just before it strikes the building.

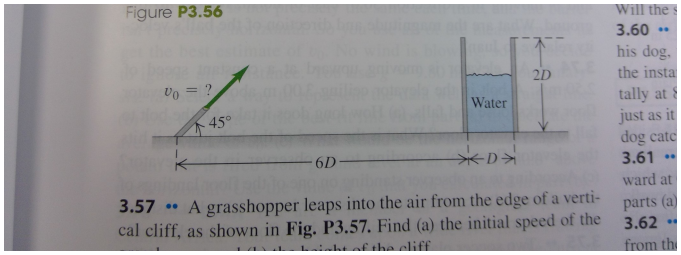
3.56 ••• A water hose is used to fill a large cylindrical storage tank of diameter D and height $2D$. The hose shoots the water at 45° above the horizontal from the same level as the base of the tank and is a distance $6D$ away (**Fig. P3.56**). For what *range* of launch speeds (v_0) will the water enter the tank? Ignore air resistance, and express your answer in terms of D and g.

Figure **P3.56**

$\Rightarrow$ How to approach?

- I need water to be above 2D from x=6D to x=7D

$\Downarrow$ $y_{yo} = \frac{V_o}{2}$



3.57 •• A grasshopper leaps into the air from the edge of a vertical cliff, as shown in **Fig. P3.57.** Find (a) the initial speed of the

$$2D = 6D - \frac{1}{2} g \frac{144D^2}{V_0^2}$$

$$4D = \frac{1}{2} g \frac{144D^2}{V_0^2}$$

$$V_0^2 = 18D \cdot g$$

$$V_0^1 = \sqrt{18D \cdot g}$$

$$\Downarrow \quad V_{y0} = \frac{V_0}{2}$$

$$V_{x0} = \frac{V_0}{2}$$

$$\frac{6D}{V_0/2} = t^1 \rightarrow \quad y(t) = 2D = 0 + \frac{V_0}{2} \cdot t - \frac{1}{2} g t^2$$

$$\Downarrow$$

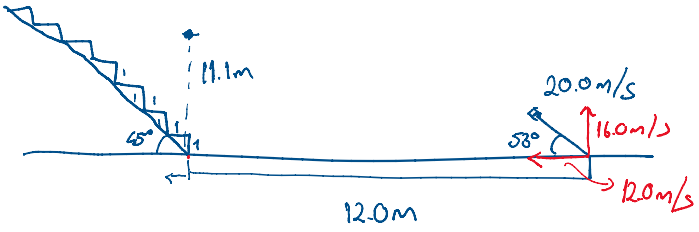
$$2D = \frac{V_0}{2} \cdot \frac{12D}{V_0} - \frac{1}{2} g \left(\frac{12D}{V_0}\right)^2$$

$$\frac{7D}{V_0/2} = t^2 \rightarrow \quad 2D = 7D - \frac{1}{2} g \frac{196D^2}{V_0^2}$$

$$V_0^2 = \sqrt{19.6 D \cdot g}$$

$\Rightarrow$

What stair will the ball hit?



1.) How high the ball would be at the first step?

$$\frac{12.0\,m}{12.0\,m/s} = 1\,sec$$

$$y = 16.0\,m/s \cdot 1\,sec - \frac{1}{2} 9.8\,m/s^2 \cdot 1^2 s$$

$$y = 11.1\,m \text{ high}$$

for each meter on the ground, it will loose;

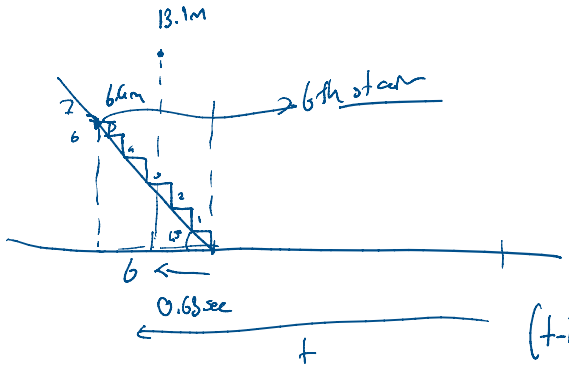
time of flight (w/o stairs)

$\downarrow$

$t = 3.2$ seconds

$y_{max} \Rightarrow 13.1\,m$

$(16.0\,m/s)^2 = 2 \cdot 9.8\,m/s^2 (y\,m)$



$$(t - 1.9)\,12.0\,m/s = 16.0\,m/s \cdot t - \frac{1}{2} 9.8 t^2$$

$$y(2.8) = 6.4\,m$$

$$12.0\,m/s \cdot t - 12.0\,m = 16.0\,m/s \cdot t - \frac{1}{2} 9.8 t^2$$

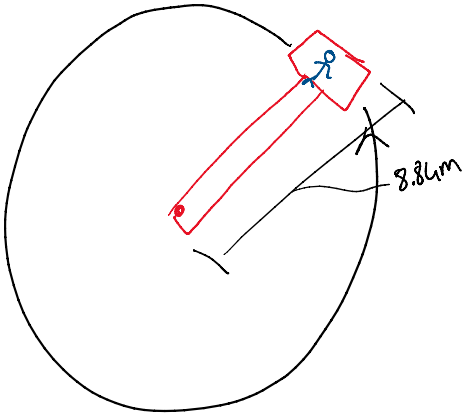
$$t^2 - \frac{4\,m/s}{4.9\,m/s^2} t - \frac{12.0\,m}{4.9\,m/s^2} = 0$$

$$\Downarrow$$

$$t = -0.4s \pm 3.2s \qquad \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= 2.8s$$

3.29



> 12.5g is the max sustained acceleration

→ how fast does he move?

$$a = \frac{v^2}{R} \qquad \sqrt{12.5g \cdot 8.84m} = v$$

> If astronaut is 200m tall what is the difference between leg and arm

$$\omega = \frac{v}{R} = \sqrt{\frac{12.5g}{8.84m}}$$

$$\omega \cdot R_1 = v_1 \rightarrow \omega R_2 = v_2 \quad (\downarrow a_2)$$

$$\Delta a = \omega^2 R_2 - \omega^2 R_1 = \omega^2 200m$$

$$= \frac{12.5g}{4.42} = 2.8g$$