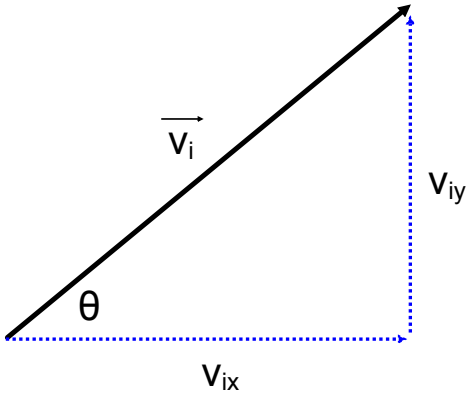
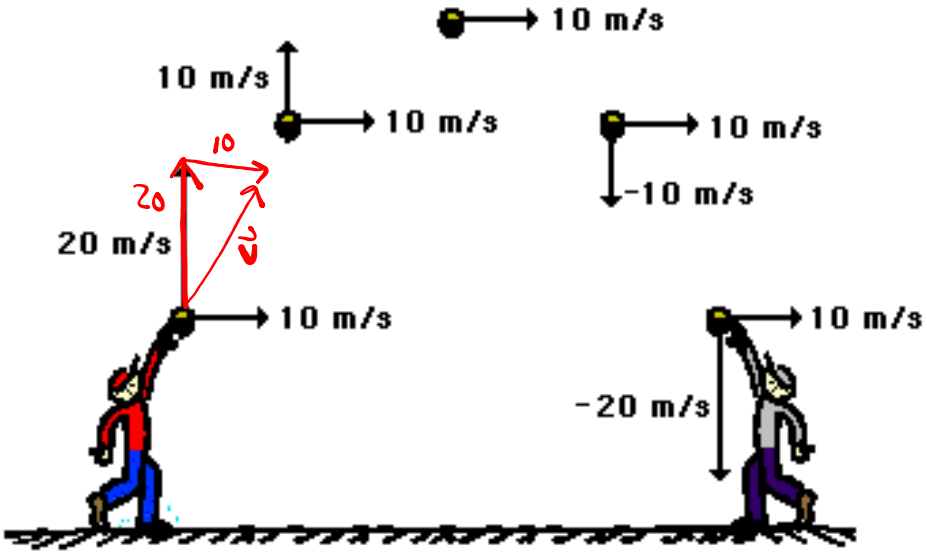
Lesson 12 - Projectile Motion - Fired at an Angle

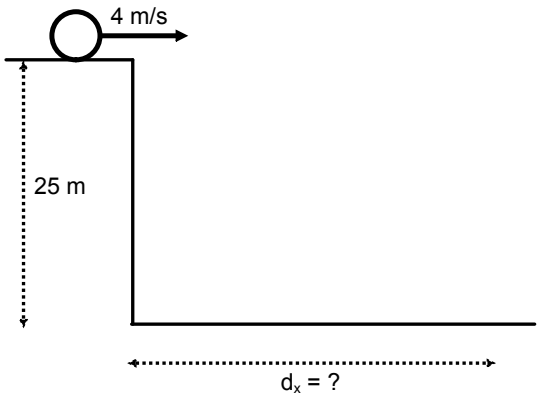
DEMO: Projectile Launcher



Independence of x- and y-Components



Horizontal Launch



x-comp

$v_x = 4 m/s$

$d_x = ?$

$t = ?$

y-comp

$v_{iy} = 0 m/s$

$a_y = -9.81 m/s^2$

$d = -25 m$

$t = ?$

$d = v_i t + \frac{1}{2} a t^2$

$-25 = (0)t + \frac{1}{2}(-9.81)t^2$

$-25 = -4.905t^2$

$\div(-4.905) \quad \div(-4.905)$

$5.0968 = t^2$

$2.26 = t$

$v_x = \frac{d_x}{t}$

$4 = \frac{d}{2.26}$

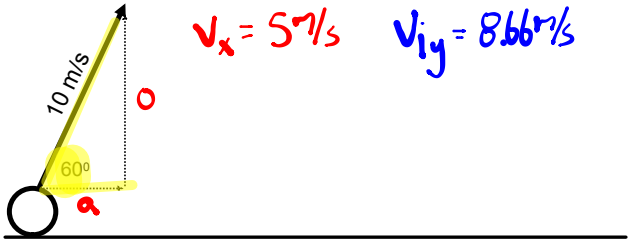
$d_x = 9.03 m$

Angled Launch

$\cos\theta = \frac{a}{h} \qquad \sin\theta = \frac{o}{h}$

$\cos 60 = \frac{v_x}{10} \qquad \sin 60 = \frac{v_{iy}}{10}$

$v_x = 5 m/s \qquad v_{iy} = 8.66 m/s$



x-comp

$v_x = 5 m/s$

$d_x = ?$

$t = ?$

y-comp

$v_{iy} = 8.66 m/s$

$a_y = -9.81 m/s^2$

$d_y = 0 m$

$t = ?$

$d = v_i t + \frac{1}{2} a t^2$

$0 = (8.66)t + \frac{1}{2}(-9.81)t^2$

$\div t \quad \div t \quad \div t$

$0 = 8.66 - 4.905t$

$+4.905t \quad +4.905t$

$4.905t = 8.66$

$\div 4.905 \quad \div 4.905$

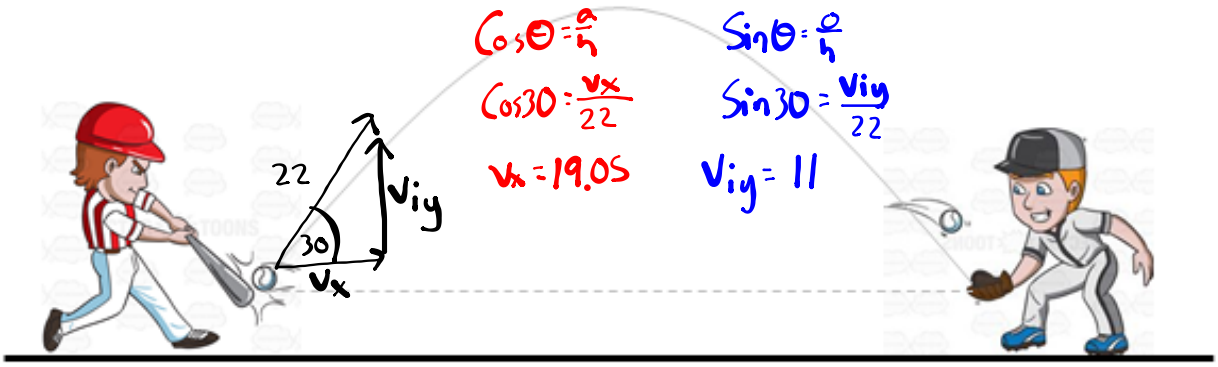
$t = 1.765597... s$

$v_x = \frac{d_x}{t}$

$5 = \frac{d_x}{1.765597...}$

$d_x = 8.83 m$

Q1: A baseball is hit with an initial velocity of 22.0 m/s [30.0°] and another player catches it from the same height from which it was launched, for long is the ball in the air?



$\cos\theta = \frac{a}{h}$ $\quad \sin\theta = \frac{o}{h}$

$\cos 30 = \frac{v_x}{22}$ $\quad \sin 30 = \frac{v_{iy}}{22}$

$v_x = 19.05$ $\quad v_{iy} = 11$

x-comp

$v_x = 19.05 m/s$

$d_x = ?$

$t = ?$

y-comp

$v_{iy} = 11 m/s$

$a_y = -9.81 m/s^2$

$d_y = 0m$

$t = ?$

$d = v_i t + \frac{1}{2} a t^2$

$0 = (11)t + \frac{1}{2}(-9.81)t^2$

$\div t \quad \div t \quad \div t$

$0 = 11 - 4.905t$

$4.905t = 11$

$t = 2.2426s$

Q2: How far did the ball travel in the horizontal component?

$v_x = \frac{d_x}{t}$

$19.05 = \frac{d_x}{2.2426}$

$d_x = 42.7m$

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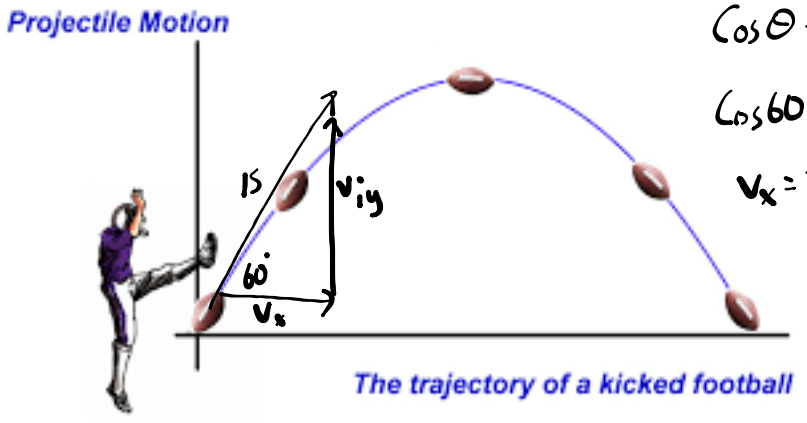
Q3: A football is punted with an initial velocity of 15 m/s [60°]. How far does it travel before hitting the field again?



$\cos\theta = \frac{a}{h}$ $\quad \sin\theta = \frac{o}{h}$

$\cos 60 = \frac{v_x}{15}$ $\quad \sin 60 = \frac{v_{iy}}{15}$

$v_x = 7.5\ m/s$ $\quad v_{iy} = 12.99\ m/s$

x-comp
$v_x = 7.5\ m/s$
$d_x = ?$
$t = ?$

y-comp
$v_{iy} = 12.99\ m/s$
$a_y = -9.81\ m/s^2$
$d_y = 0\ m$
$t = ?$

$d = v_i t + \frac{1}{2} a t^2$

$0 = (12.99)t + \frac{1}{2}(-9.81)t^2$

$\div t \quad \div t \quad \div t$

$0 = 12.99 - 4.905t$

$t = 2.6483...\ s$

$v_x = \frac{d_x}{t}$

$7.5 = \frac{d_x}{2.6483}$

$d_x = 19.86\ m$

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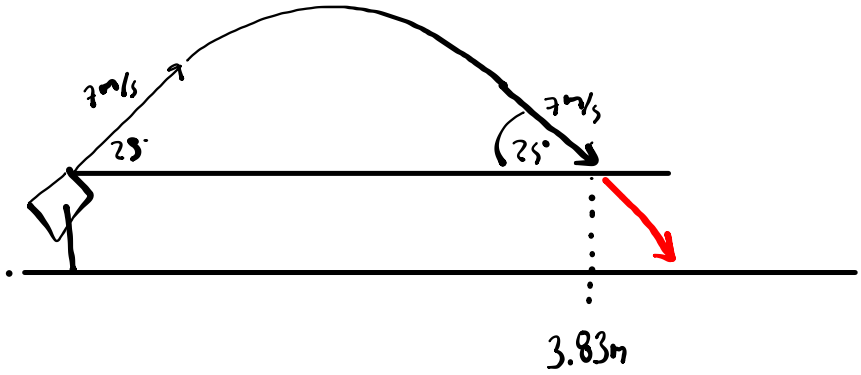
Demo: Projectile Launcher

Q4: Where will it land if it is launched at 7.00 m/s and at an angle of 25°?



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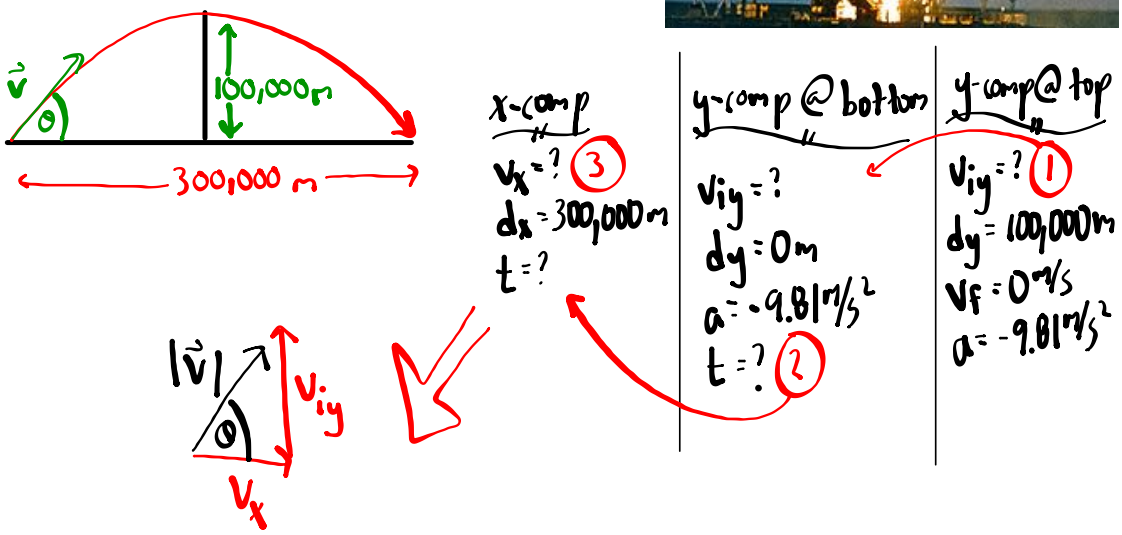
Q5: A German U2 rocket from the second world war had a range of 300 km reaching a maximum height of 100 km. Determine the rockets initial speed.

Step #1: Draw your diagram.

Step #2: Before starting any Math, what is your plan?



Practice:

Pg 109 # 2
Pg 111 #1
Check and Reflect Pg 112 #6, 8, 9
Try P. 112 #7