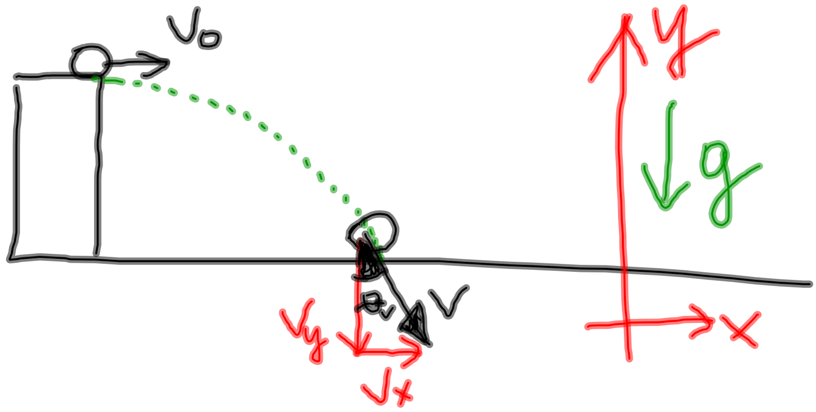
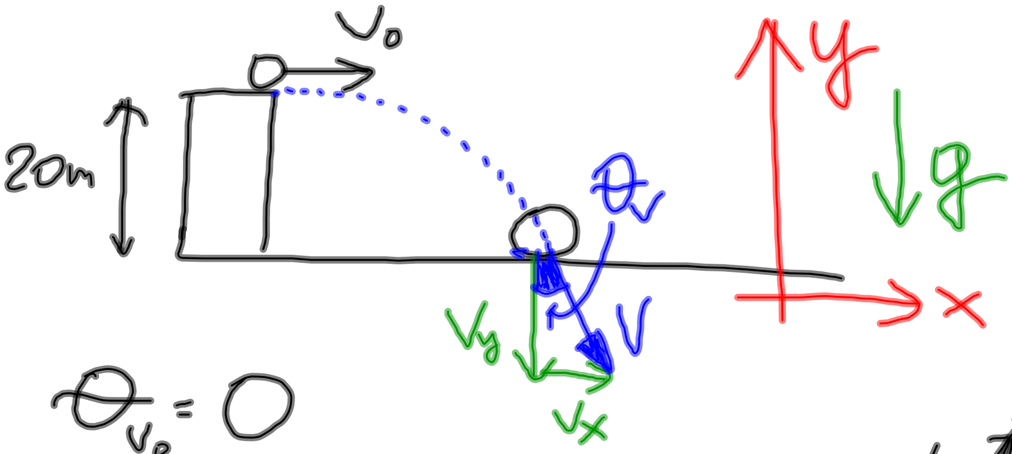
1. A ball is tossed horizontally at the initial velocity of 30 m/s from a height of 20 m.
a) Total time in the air (hang time)?
b) Horizontal displacement (range)?
c) Final velocity just an instant before the ball hits the ground?



Oct 27-9:51 AM



$\theta_{V_o} = 0$

$V_{ox} = V_o \cdot \cos 0^\circ = V_o$

$V_{oy} = V_o \cdot \sin 0^\circ = 0$

Oct 27-12:59 PM

x	y
$a_x = 0$	$g = -9.8\,\frac{m}{s^2}$
$V_{0x} = 30\,\frac{m}{s}$	$V_{0y} = 0$
$V_x = V_{0x} = 30\,\frac{m}{s}$	$V_y = ?$
$\Delta x = ?$	$\Delta y = -20\,m$
$t = ?$	$t = ?$

Oct 27-1:01 PM

x	y
$V_{0x} = 30\,\frac{m}{s}$	$V_{0y} = 0$
$V_x = V_{0x} = 30\,\frac{m}{s}$	$V_y = ?$
$a_x = 0$! ALWAYS!	$g = -9.8\,\frac{m}{s^2}$
$\Delta x = ?$	$\Delta y = -20\,m$
$t = ?$	$t = ?$

Oct 27-9:57 AM

(y)

$\Delta y = V_{oy}t + \frac{1}{2}gt^2$ ($V_{oy} \to 0$)

a) $-20 = \frac{1}{2}(-9.8)t^2$

$-20 = -4.9t^2$

$t = 2.02\ s$

Oct 28-9:07 AM

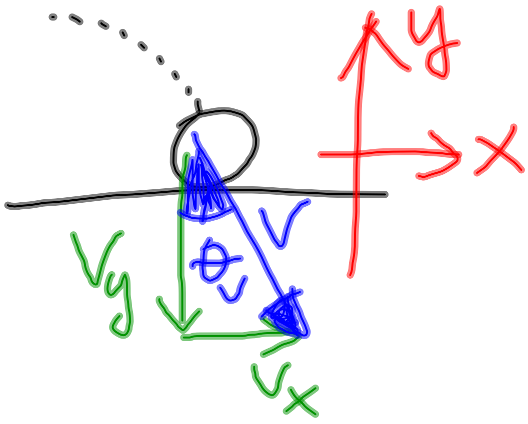
b) (x) $\Delta x = \frac{1}{2}(V_{ox} + V_x)t$

$\Delta x = \frac{1}{2}(30 + 30)(2.02)$

$\Delta x = 60.6\ m$

Oct 28-9:19 AM

c) $V = \sqrt{V_x^2 + V_y^2}$



(x) $V_x = V_{0x} = 30 \frac{m}{s}$

(y) $V_y = V_{0y} + gt$

$V_y = 0 - 9.8(2.02)$

$\boxed{V_y = -19.8 \frac{m}{s}}$

Oct 28-9:27 AM

$V = \sqrt{V_x^2 + V_y^2}$

$V = \sqrt{(30)^2 + (-19.8)^2}$

$\boxed{V = 36.0 \frac{m}{s}}$

Oct 28-9:35 AM

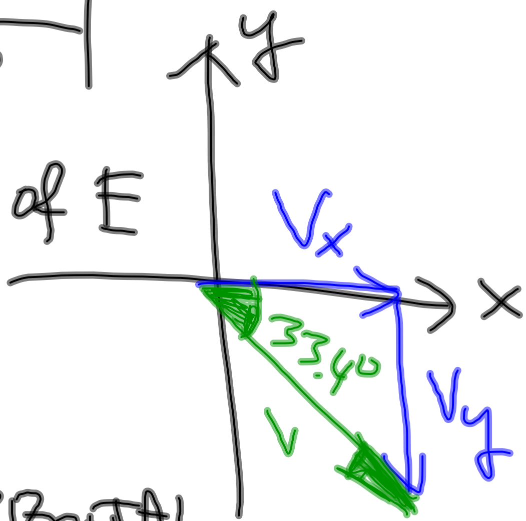
$$\theta = \tan^{-1}\left|\frac{V_y}{V_x}\right|$$

$$\theta = \tan^{-1}\left|\frac{-19.8}{30}\right|$$

$$\theta = 33.4^\circ \text{ S of E}$$

E 33.4° S

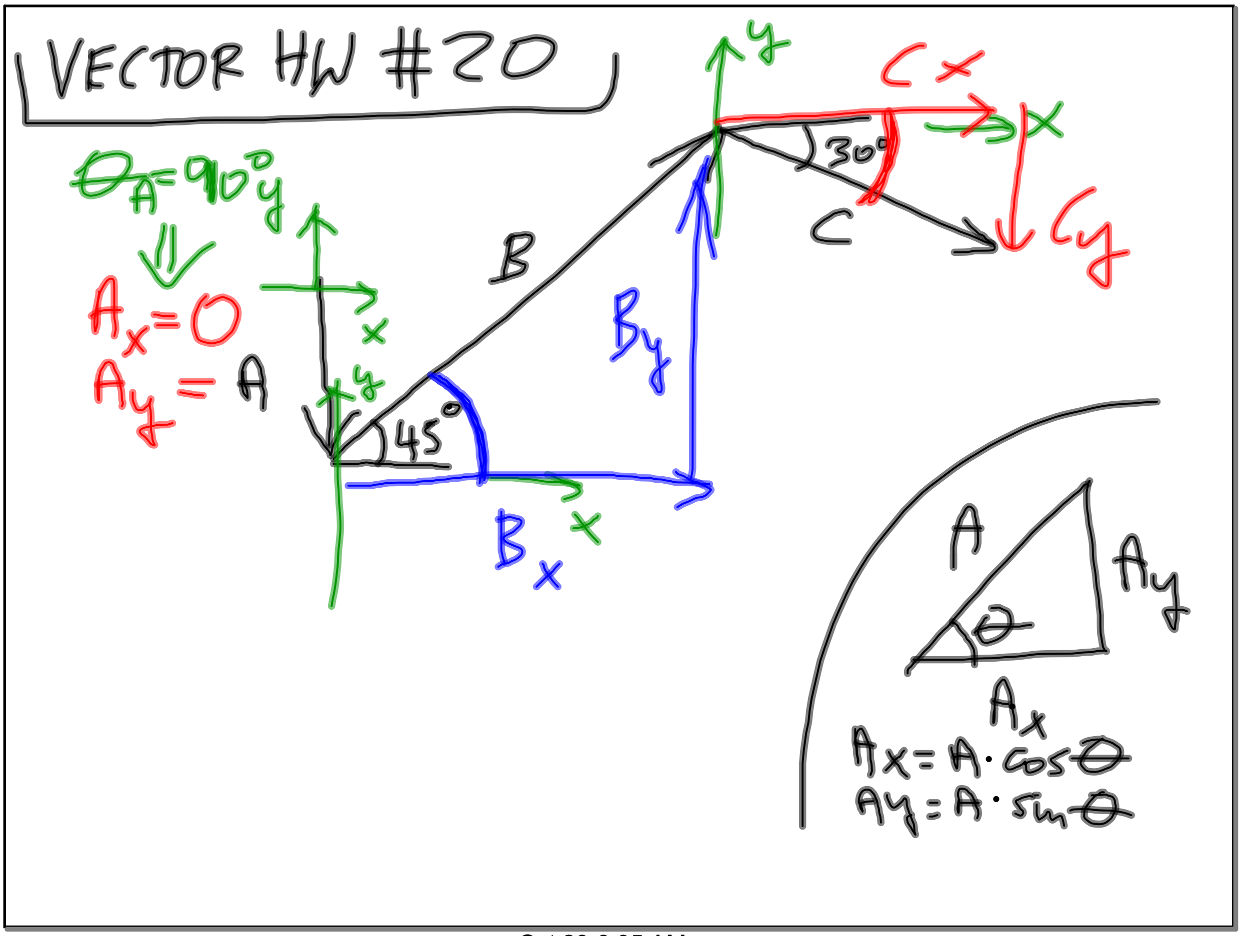
$\theta_V = 33.4^\circ$ BELOW THE HORIZONTAL



Oct 28-9:45 AM

Practice problem.
A rocket is fired with the initial horizontal velocity of 60 m/s from a rooftop of a building which is 80 m high.
a) Total time in the air?
b) Range of the rocket?
c) Final velocity an instant before the impact with the ground?

Oct 28-9:49 AM



Oct 28-8:35 AM

$R = A + B + C$

$R_x = A_x + B_x + C$

$R_x = 0 + 14.14 + 6.06$

$R_x = 20.2\ m$

$R_y = A_y + B_y + C_y$

$R_y = -10 + 14.14 - 3.5$

$R_y = 0.64\ m$

Oct 28-8:40 AM

$$R = \sqrt{R_x^2 + R_y^2}$$

$$R = \sqrt{(20.2)^2 + (0.64)^2}$$

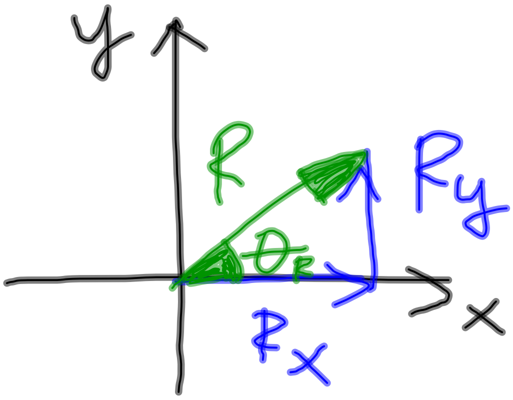
$$\boxed{R = 20.2 \text{ m}}$$

$$\theta = \tan^{-1}\left|\frac{R_y}{R_x}\right|$$

$$\theta = \tan^{-1}\left|\frac{0.64}{20.2}\right|$$

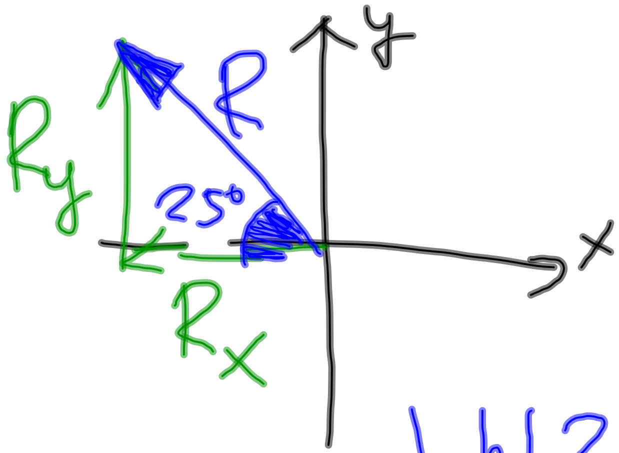
$$\boxed{\theta = 1.81^\circ}$$

Oct 28-8:43 AM



$$\boxed{\text{E } 1.81^\circ \text{ N}}$$

Oct 28-8:45 AM



R_x (−)

R_y (+)

$\theta = 25°$

W25°N

Oct 28-8:50 AM