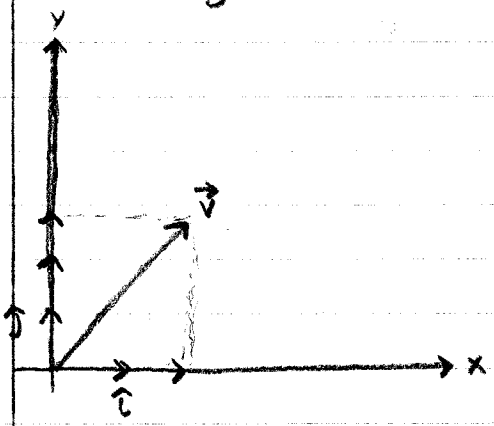
12-12-07

$\vec{v} = \vec{v}_x + \vec{v}_y$

in fact $\vec{v}_x$, $\vec{v}_y$ can be orthogonal



$\vec{v} = 2\hat{i} + 3\hat{j}$

every vector can be written as a linear combination of the basis vectors $\hat{i}, \hat{j}, \hat{k}$

[ex. 1] $\vec{v} = \begin{bmatrix} 3 \\ 1 \\ -5 \end{bmatrix}$

write $\vec{v}$ as a linear combination of its basis vectors

$\vec{v} = 3\hat{i} + \hat{j} - 5\hat{k}$

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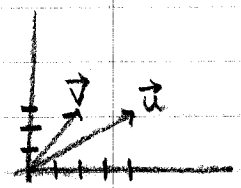
projectile motion
(all motion)

the $\hat{i}, \hat{j}, \hat{k}$ components have no effect on each other
(Galileo)

- but they do affect the vectors

[ex.1] $\vec{v} = 2\hat{i} + 3\hat{j}$

$\vec{u} = 4\hat{i} + 3\hat{j}$



so doubling $2\hat{i}$ effects vector, but not effect $\hat{j}$

now,

Let $\vec{v}_x = 3t\hat{i}$

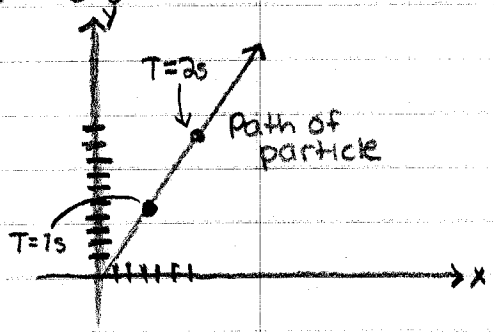
$\vec{v}_y = 5t\hat{j}$

Then $\vec{v}(t) = 3t\hat{i} + 5t\hat{j}$

Plot the motion of particle whose velocity is given by

$\vec{v}(t) = 3t\hat{i} + 5t\hat{j}$

t	3t	5t
0	0	0
1	3	5
2	6	10

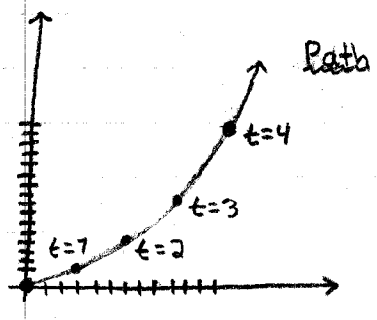


Q1 How far does particle get in 10s in

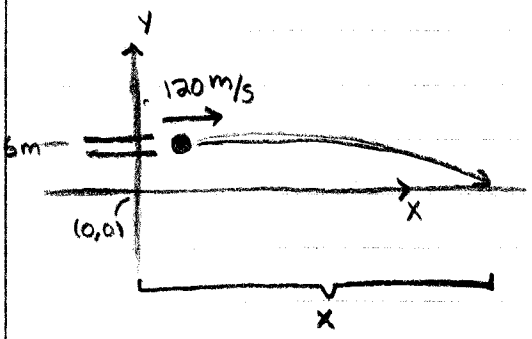
- x-direction 30 distance units
- y-direction 50 distance units

[ex. 2] $\vec{v}(t) = 3t\hat{i} + t^2\hat{j}$

t	$3t$	t^2
0	0	0
1	3	1
2	6	4
3	9	9
4	12	16



[ex. 3] Cannon fires parallel to level ground with horizontal velocity of 120 m/s. Where does cannon ball land? cannon barrel at 6m above ground.



$x(t) = 120\,m/s\,t$

$y(t) = 6m - \frac{1}{2}(9.81\,m/s^2)\,t^2$] you'll find t from this

hits ground

$6m - 4.9t^2 = 0$

$t^2 = \frac{6}{4.9}$

$t = \sqrt{\frac{6}{4.9}}$

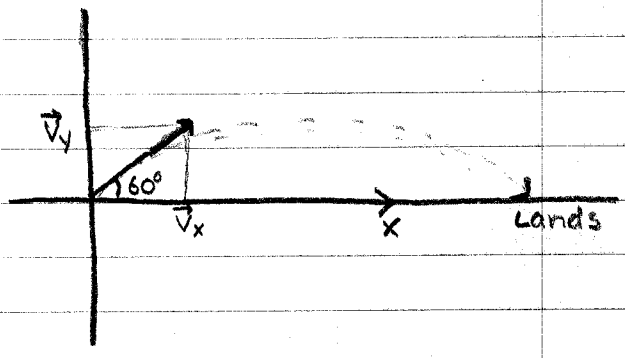
$t = 1.1$ sec

$x(1.1) = 120\,m/s\,(1.1s)$

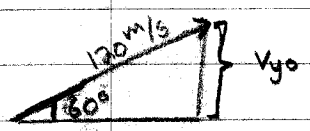
$= 132m$

cannon ball lands 132m away

[ex. 5] cannon fires at angle of 60° w/ respect to ground. Muzzle velocity is 120 m/s.
where does cannonball land?
Barrel at zero m above ground



$x(t) = 120^{m/s} t$, t is time in air
$y(t) = \vec{V}_y t - \frac{1}{2}(9.8)t^2$
need $\vec{V}_y$



$\sin 60° = \frac{V_{y_0}}{120}$

$\Rightarrow V_{y_0} = 120 \sin 60°$
$= 120(\frac{1}{2})$
$= 60^{m/s}$

$\cos 60° = \frac{V_{x_0}}{120}$

$V_{x_0} = 120 \cos 60$
$= \frac{\sqrt{3}}{2}(120)$
$= \sqrt{3}(60)$
$\approx 103^{m/s}$