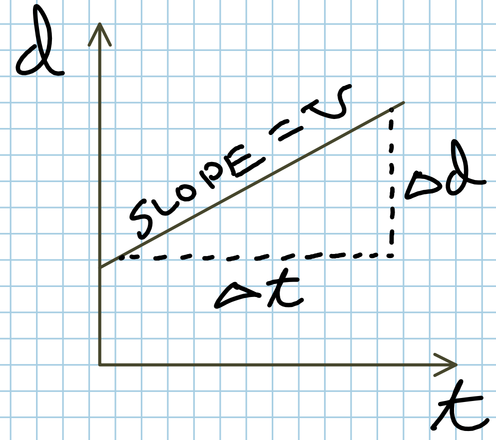
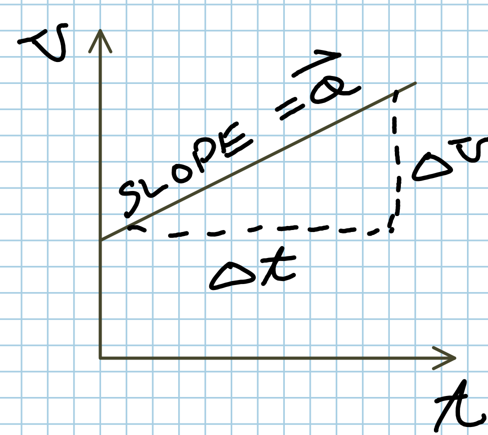
KINEMATICS

Monday, October 19, 2015
11:48 AM

THE STUDY OF MOTION, WITHOUT ASKING WHY.

GR 10: $\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$ AND $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$





GR 11: THE "BIG FOUR" KINEMATICS EQUATION

SAME THIS YEAR

(GR 12) $\bar{v} = \left(\frac{v+v_0}{2}\right)$ AND $d = \bar{v}t$

$d = \left(\frac{v+v_0}{2}\right)t$ ← (GR 11)

THIS YEAR: WE GO 2-D!

SAME 5 VARIABLES, TIMES TWO!

v_0, v, t, a, d IN x AND y

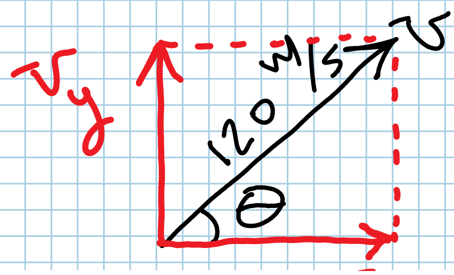
THAT'S 10 VARIABLES!

USE A DATA TABLE! PROBLEMS COMING...

PROBLEM: ALL KINEMATICS FORMULAE (THE BIG FOUR) ARE ONE DIMENTIONAL THEY MAY ONLY BE USED IN ONE-D AT A TIME.

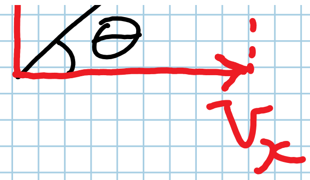
SOLUTION: ONLY DEAL WITH ONE DIMENTION AT A TIME. THIS REQUIRES VECTOR COMPONENTS.

EX IF WE HAVE A VECTOR WHICH POINTS IN A DIRECTION WE DON'T LIKE, WE MAY REPLACE THAT VECTOR WITH TWO (OR MORE) "COMPONENT" VECTORS WHICH ADD UP TO THE ORIGINAL.



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

(IN 2-D)



(IN 2-D)

$$v_x = 120 \cos\theta$$
$$v_y = 120 \sin\theta$$

} COMPONENTS IN x AND y

PROJECTILE PROBLEMS

① A BALL IS THROWN OVER LEVEL GROUND AT 13 m/s [40° ABOVE HORIZONTAL]. FIND THE RANGE OF THE BALL.

(HORIZONTAL DISPLACEMENT, d_x)

TABLE:

	x	y
v_0	13 cos 40°	13 sin 40°
v	13 cos 40°	−13 sin 40°
a	0	−9.80
t	1.7	= 1.7 ←

USE VERTICAL (y) DATA ONLY

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a}$$

t	1.7	= 1.7
d	?	0

$t = \frac{v - v_0}{a}$

$= \frac{-13 \sin 40^\circ - 13 \sin 40^\circ}{-9.80}$

$= 1.705\ s$

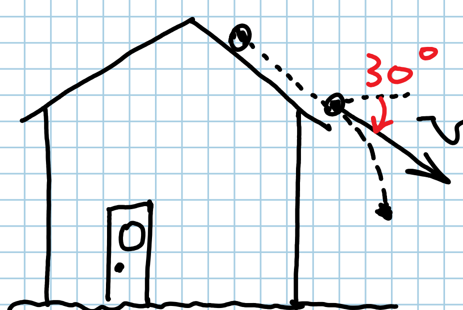
⇓

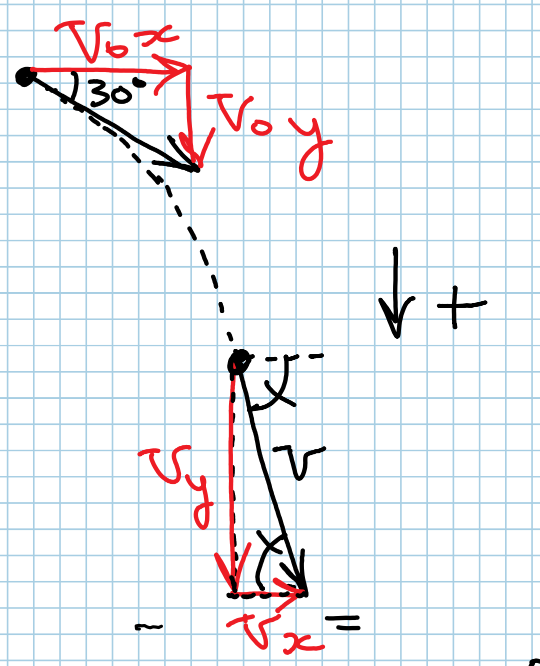
$d_x = v_x t$

$= (13 \cos 40^\circ)(1.70)$

$d_x = 17\ m$

Ex ② A ROCK ROLLS OFF OF A ROOF AT AN ANGLE OF 30.0° BELOW HORIZONTAL (AS SHOWN). FIND THE VELOCITY AFTER 1.00 S.





	x	y
v_0	3.5 cos 30°	3.5 sin 30°
v	3.5 cos 30°	?
d	—	—
a	0	9.80
t	1.00	= 1.00

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

$t \mid 1.00 \mid 1.00$

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

$v = \sqrt{v_x^2 + v_y^2}$

$\Downarrow$

$v_y = v_{0y} + a_y t$

$= 3.5 \sin 30^\circ + 9.80(1.00)$

$= 1.75 + 9.80$

$v_y = 11.55 \ \frac{m}{s}$

$v = \sqrt{(3.5 \cos 30^\circ)^2 + (11.55)^2}$

$v = 11.94 \ \frac{m}{s} = 12 \ \frac{m}{s}$

$\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right) = \tan^{-1}\left(\quad \right) = 75^\circ$

$\vec{v} = 12 \ \frac{m}{s}$ [75° BELOW HORIZONTAL]

#2 KEY ~~d~~ a