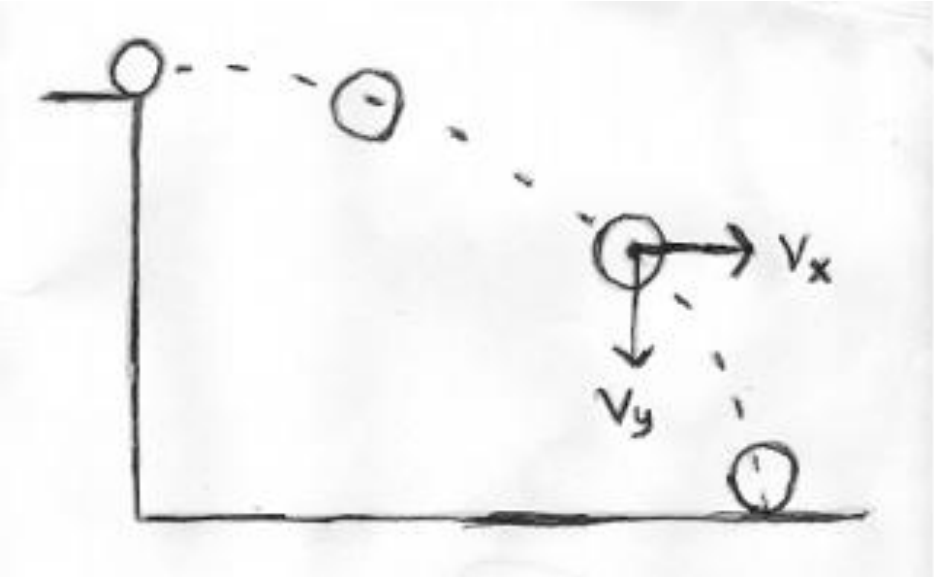
A lunatic drives his car off the edge of a 20.0m tall cliff with a velocity of 12m/s.

a. Using the diagram below, draw in the length of the velocity vectors throughout the car's motion. One of them has already been done for you. Make sure you label your vectors.



b. Determine the time it takes for the lunatic's car to crash into the ground.

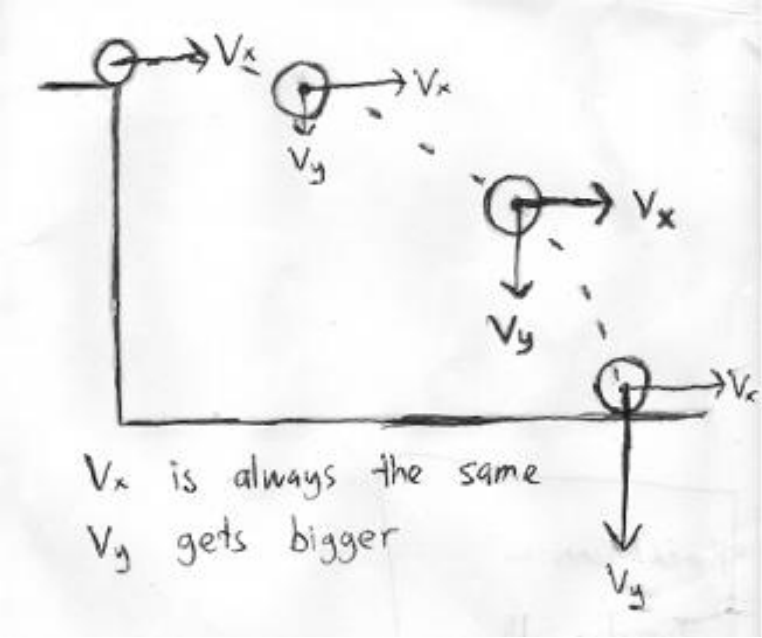
c. Determine the range the car.

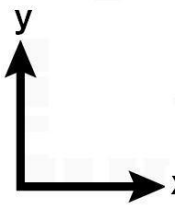
d. Determine the final vertical velocity of the car.

e. Determine the total final velocity of the car.

f. Determine the angle at which the car hits the ground.

a.





Choose a coordinate system.

b. $v_{iy} = 0m/s$ $a_y = -9.80m/s^2$ $d_y = -20.0m$ $t = ?$	$d = v_i t + \frac{1}{2}at^2$ $d = 0 + \frac{1}{2}at^2$ $d = \frac{1}{2}at^2$ $\frac{2d}{a} = t^2$ $t^2 = \frac{2d}{a}$ $\sqrt{t^2} = t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(-20.0m)}{(-9.80m/s^2)}} = 2.02s$
c. $v_x = 12.0m/s$ $t = 2.02s$ $d_x = ?$	$v_x = \frac{d_x}{t}$ $v_x t = d_x$ $d_x = v_x t = (12.0m/s)(2.02s) = 24.2m$

d. $v_{iy} = 0m/s$ $a_y = -9.80m/s^2$ $d_y = -20.0m$ $v_{fy} = ?$	$v_f{}^2 = vi^2 + 2ad$ $v_f{}^2 = 0 + 2ad$ $v_f{}^2 = 2ad$ $v_f = \pm\sqrt{2ad} = \pm\sqrt{(2)(-9.80m/s^2)(-20.0m)}$ $v_f = -19.8m/s$ $v_{fy} = -19.8m/s$
e.	$v_{fx}{}^2 + v_{fy}{}^2 = v_{total}{}^2$ $v_{total}{}^2 = v_{fx}{}^2 + v_{fy}{}^2$ $\sqrt{v_{total}{}^2} = v_{total} = \sqrt{v_{fx}{}^2 + v_{fy}{}^2}$ $v_{total} = \sqrt{(12m/s)^2 + (-19.8m/s)^2}$ $v_{total} = 23.2m/s$
f. 58.8 degrees below the horizontal. or 58.8 degrees south of east.	$\tan\theta = \frac{opposite}{adjacent} = \frac{opp}{adj} = \frac{19.8}{12}$ $\tan\theta = \frac{19.8}{12}$ $\tan^{-1}(\tan\theta) = \tan^{-1}\left(\frac{19.8}{12}\right)$ $\theta = \tan^{-1}\left(\frac{19.8}{12}\right) = 58.8°$