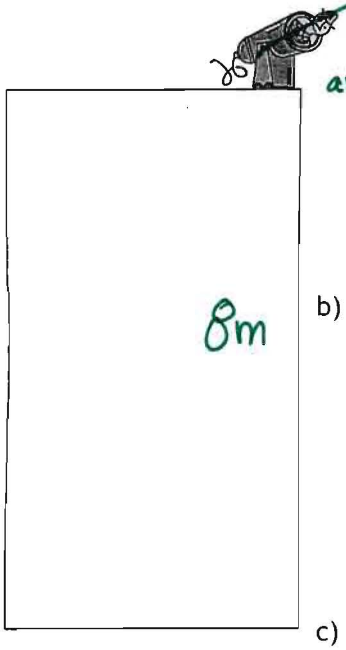
AP Physics
2D and Vectors

Name:____________________________
Period: 2-3A 3B-4 5-6A 6B-7

The Dixie Dazzler attempts to launch himself out of a cannon and land safely in a pile of straw. He is launched from the top of an 8 meter building, at a speed of 30 m/s, and at an angle of 20°.



a) What are vertical and horizontal components of The Dazzler's launched velocity?

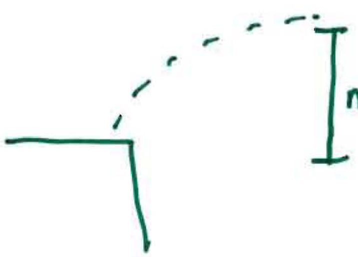
30 m/s
angle = 20°

$x = 30 \cos\theta = 28.2\ \text{m/s}$

$y = 30 \sin\theta = 10.3\ \text{m/s}$

$\boxed{x = 28.2\ \text{m/s},\quad y = 10.3\ \text{m/s}}$

b) What is The Dazzler's maximum height reached from the ground? Y-direction



$v_f = 0$
$v_1 = 10.3\ \text{m/s}$
$a = -9.8\ \text{m/s}^2$
$\Delta y = ?$

~~$\Delta y = v_1 t + \frac{1}{2}at^2$~~
~~$\Delta y = 10.3$~~

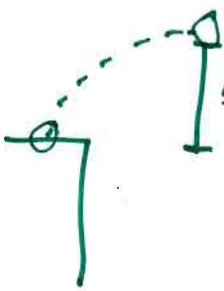
$v_f^2 = v_1^2 + 2a\Delta y$

$0 = (10.3)^2 + 2(-9.8)\Delta y$

$\boxed{13.37\ \text{m}}$ (From ground)

$\Delta y = 5.37\ \text{m}$ + 8 m

c) How much time does it take The Dazzler to reach a maximum height? Y-Direction



$v_{1y} = 10.3\ \text{m/s}$
$v_f = 0$
$\Delta y = 5.37$
$a = -9.8\ \text{m/s}^2$
$t = ?$

$\frac{v_f - v_1}{t} = a$

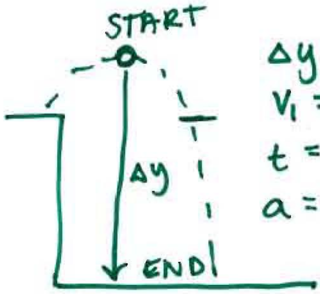
$\frac{v_f - v_1}{a} = t$

$\frac{0 - 10.3}{-9.8} = t$

$t = 1.05$

~~1.05s~~ $\boxed{t = 1.05\ \text{s}}$

d) How far should the pile of straw be placed from the edge of the building so The Dazzler lands safely?



y

$\Delta y = -13.37\ \text{m}$
$v_1 = 0\ \text{m/s}$
$t = ?$
$a = -9.8\ \text{m/s}^2$

$\Delta y = v_1 t + \frac{1}{2}at^2$

$-13.37 = 0 + \frac{1}{2}(-9.8)t^2$

$13.37 = 4.9t^2$

$t = 1.65\ \text{s}$ way Down

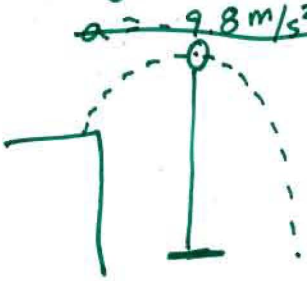
x

$v_x = 28.2$
$t = 1.65 + 1.05 = 2.7$
$\Delta x = ?$
$v = \frac{\Delta x}{t}$
$28.2 = \frac{\Delta x}{2.7}$

$\boxed{76.14\ \text{m}}$

e) How far from the base of the building should a flaming hoop be placed to take The Dazzler's trick to the next level?

~~$\Delta y = 5.37\ \text{m}$~~
~~$a = -9.8\ \text{m/s}^2$~~



x

time to get to hoop From Pt c

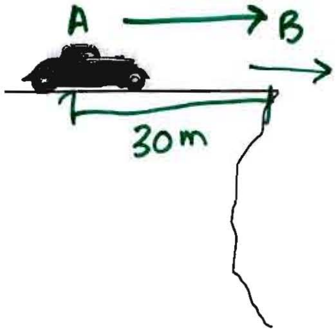
$t = 1.05\ \text{s}$
$v_x = 28.2\ \text{m/s}$
$\Delta x = ?$

$v_x = \frac{\Delta x}{t}$

$28.2 = \frac{\Delta x}{1.05}$

$\boxed{29.61\ \text{m} = x,\quad 13.37\ \text{m} = y}$

Starting from rest, a car drives towards the end of a 70 m cliff. The car takes off with an acceleration of 8m/s/s, 30 m from the cliff's edge.



a) With what speed does the car drive off the cliff?

$V_1 = 0$
$V_f = ?$
$a = 8 m/s^2$
$\Delta x = 30m$

$V_f^2 = V_1^2 + 2a\Delta x$
$V_f^2 = 0 + 2(8)(30)$
$V_f = 21.9 m/s$

$\boxed{21.9 m/s}$

b) How long is the car in the air?

70m cliff

y
$\Delta y = -70 m$
$a = -9.8 m/s^2$
$V_{iy} = 0$
$t = ?$

$\Delta y = V_1 t + \frac{1}{2}at^2$
$-70 = 0 + \frac{1}{2}(-9.8)t^2$
$70 = 4.9t^2$
$t = 3.78$

$\boxed{3.78 s}$

c) How far from the base of the cliff does the car land?

x
time in air = 3.78s
$V_x = 21.9 m/s$ (From A)
$\Delta x = ?$

$V_x = \frac{\Delta x}{t}$
$21.9 m/s = \frac{\Delta x}{3.78}$
$\Delta x =$

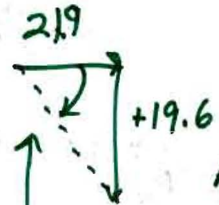
$\boxed{82.78 m}$

d) What is the velocity of the car 2 seconds after it leaves the cliff?

V_y
$V_{iy} = 0$
$a = -9.8 m/s^2$
$t = 2$
$V_f = ?$

$\frac{V_f - V_1}{t} = a$
$\frac{V_f - 0}{2} = -9.8 m/s^2$
$V_f = -19.6 m/s$

$\boxed{V_x \text{ is } 21.9 !}$ @ 0°
$\boxed{V_y \text{ is } -19.6 m/s @ 90°}$
OR 19.6 m/s @ 270°



$A^2 + B^2 = C^2$
magnitude = 29.4 m/s
(Hypotenuse)
$\tan\theta = \frac{19.6}{21.9}$ $\theta = 41.8°$

$\boxed{29.4 m/s @ -41.8° \text{ OR } 29.4 m/s @ 318.2°}$