These are NOT notes. They are a visual aid(20%) for a verbal explanation(80%).

@ $t = t_{top}$, $y = y_{top}$, $x = x_{top}$, $V_y|_{t=top} = 0$ ★

[4] $V_y|_{t=t_{top}} = 0 = 7.5 - 9.8 t_{top}$ ★!!

$\therefore \; t_{top} = \frac{7.5}{9.8} = 0.765$ seconds

★ [2] $\Rightarrow \quad y_{Top} = 7.5 t_{top} - 4.9 t_{top}^2 = 2.87$ meters

[1] $\Rightarrow \quad x_{Top} = 13 t_{top} = 9.95$ meters

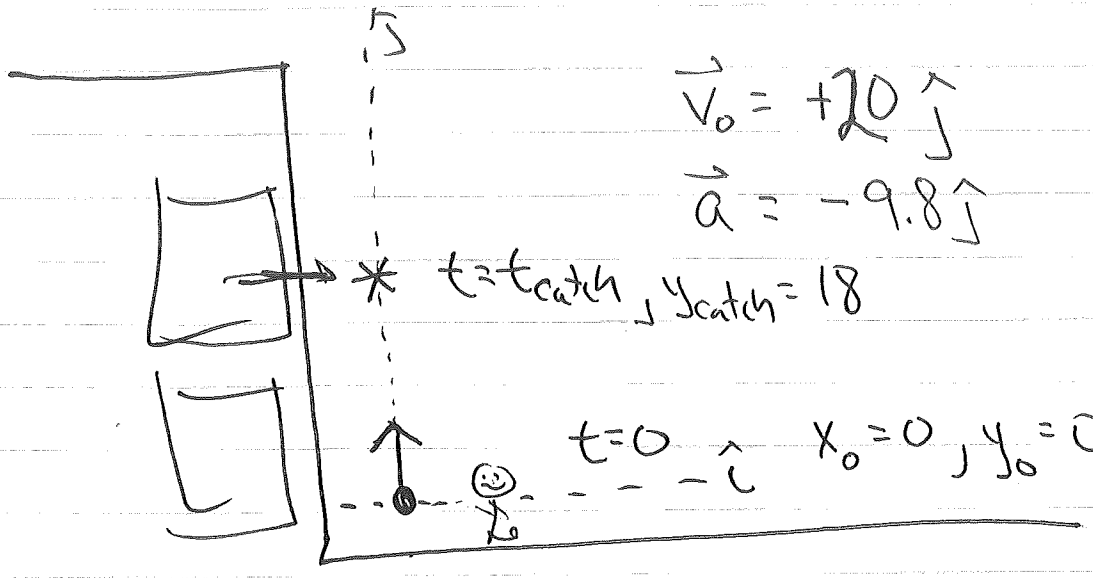
[3] $\Rightarrow \quad V_x|_{t=t_{top}} = 13$ m/s

$\vec{V}|_{t=t_{top}} = V_y|_{t=t_{top}} \hat{j} + V_x|_{t=t_{top}} \hat{i} = 13\hat{i}$

★ Rock is 102.87 m above base of cliff.

Ex.] You have left the dorm w/ your roommate's car keys. She shouts @ you from the 2nd floor window (you walk over). You throw the keys up to her w/ an initial velocity of 20 m/s (↑). The window is 18 m above the point where you released the keys.

How long after you threw them does she catch them?
How fast are they moving when she catches them?



1-d

$$y(t) = y_0 + v_0 t + \tfrac{1}{2} a t^2$$
$$v(t) = v_0 + at$$

$$y(t) = 20t - 4.9t^2 \quad [1]$$
$$v(t) = 20 - 9.8t \quad [2]$$

Done!!

@ $t = t_{catch}$, $y = y_{catch} = 18$, $v = v_{catch}$

(1) $\Rightarrow$ $18 = 20t_{catch} - 4.9t_{catch}^2$

$4.9t_{catch}^2 - 20t_{catch} + 18 = 0$

$\therefore t_{catch} = \dfrac{+20 \pm \sqrt{400 - 4(4.9)(18)}}{9.8}$

1.34 seconds OR 2.74 seconds

(2) $v_{catch} = 20 - 9.8t_{catch}$

$+6.87\ m/s$ OR $-6.85\ m/s$

EXPECT SAME from Symmetry of Problem.

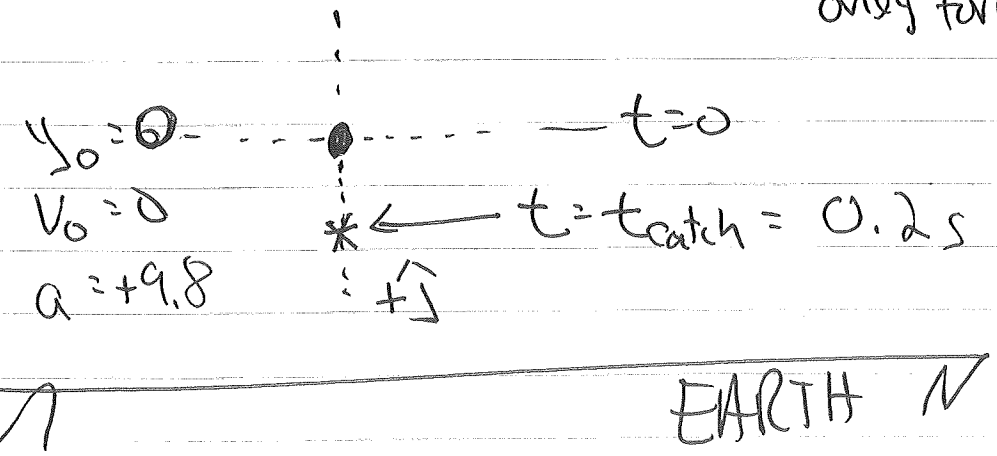
If it is not caught on way up, what maximum height does it reach?
What is its speed @ that maximum height?

L.T.K.

EX] Reaction time is typically 0.2 seconds.

How far will an object "free fall" in that time?

"free fall" — Force of gravity is only force



$$\begin{cases} y(t) = y_0 + v_0 t + \frac{1}{2}at^2 \\ v(t) = v_0 + at \end{cases}$$

$$\begin{cases} y(t) = +4.9t^2 & (1) \\ v(t) = +9.8t & (2) \end{cases}$$

@ $t = t_{catch}$, $y = y_{catch}$, $v_{catch} = ?$

(1) $\Rightarrow$ $y_{catch} = 4.9(0.2)^2 = \underline{0.196}$ meters

(2) $\Rightarrow$ $v_{catch} = 9.8(0.2) = \underline{1.96}$ m/s