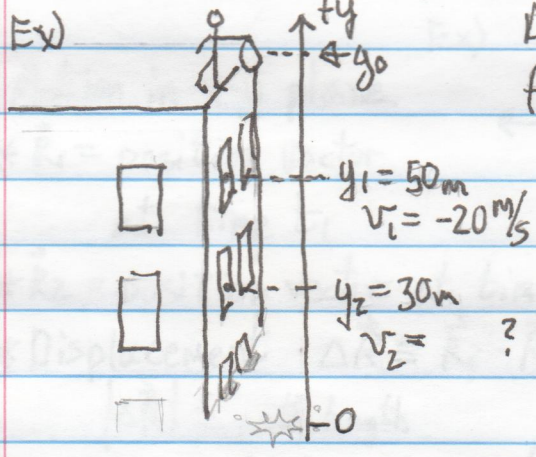
Free Fall / review problems

Ex)



Dude drops water balloon at $t=0$ from height $y_0 = (?)$. Given: $a = 9.8$ down

$y_1 = 50, y_2 = 30$

$v_1 = -20$

(a) Find v_2 3.14, E

Soln: $v_2^2 - v_1^2 = 2a(y_2 - y_1)$ ← (2.17)

with $v_1 = -20$, $a = -9.8$, $y_2 - y_1 = 30 - 50 = -20$

$v_2^2 - 20^2 = 2(-9.8)(-20)$

$v_2^2 = 400 + 392$

$v_2 = \sqrt{792} = \boxed{28.14\ \text{m/s}}$

b) Assuming $v_0 = 0$, what was y_0?

Soln: $v_1^2 - v_0^2 = 2a_y(y_1 - y_0)$ (E)

$(-20)^2 - 0 = 2(-9.8)(50 - y_0)$

$400 = -19.6 \times 50 + 19.6 y_0$

$\frac{400 + 980}{19.6} = y_0$

$\boxed{y_0 = 70.4\text{ m}}$

c) How long does it take to splash down?

$y(t_{splash}) = y_0 + v_{oy} t_s + \frac{1}{2} a t_s^2$ (3.13) b

$0 = 70.4 + 0 - \frac{9.8}{2} t_s^2$

$-70.4 = -4.9 t_s^2$

$14.4s = t_s^2 \Rightarrow \boxed{t_s = 3.79\text{ sec}}$

Note: when $v_{oy} \neq 0$, use quadratic formula:

$at^2 + bt + c = 0$ ($c \leftrightarrow (y - y_0)$)

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

d) How fast is it moving at t_s?

$v_y(t_s) = v_{oy} + a_y t_s$ ← (2.13) 3.12, C

$v_y(t_s) = 0 + -9.8(3.79)$

$\boxed{v(t_s) = 37.15\ \text{m/s}}$