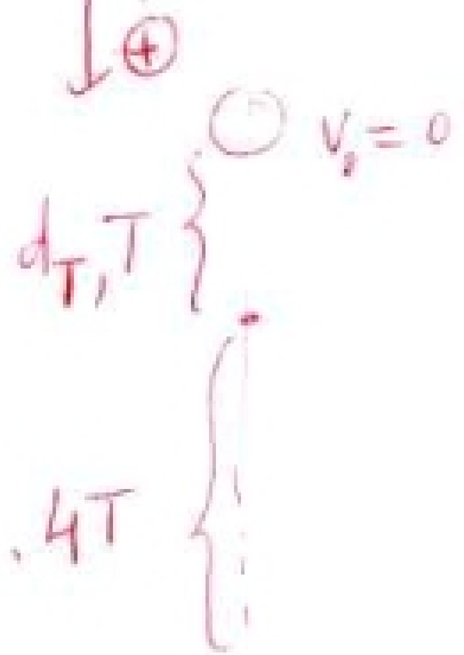
Homework solution #2

①



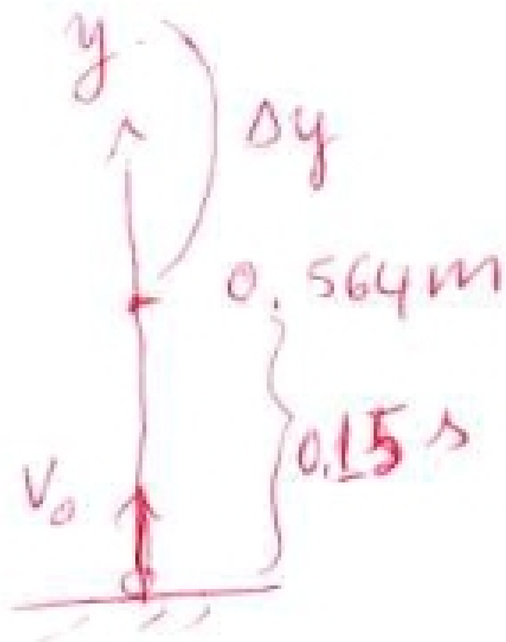
$$d = y - y_0 = \frac{1}{2}gT^2$$

$$d_T = +\frac{1}{2}gT^2$$

$$d_{5T} = \frac{1}{2}g(5T)^2 = 25\, d_T$$

$$d_{4T} = d_{5T} - d_T = 25d_T - d_T = 24\, d_T$$

②



(a) $$y = y_0 + v_{oy}t - \frac{1}{2}gt^2$$

$$0.564 = 0 + v_{oy}(0.15s) - \frac{1}{2}(9.81\,m/s^2)(0.15s)^2$$

$$v_{oy} = 4.5\,m/s.$$

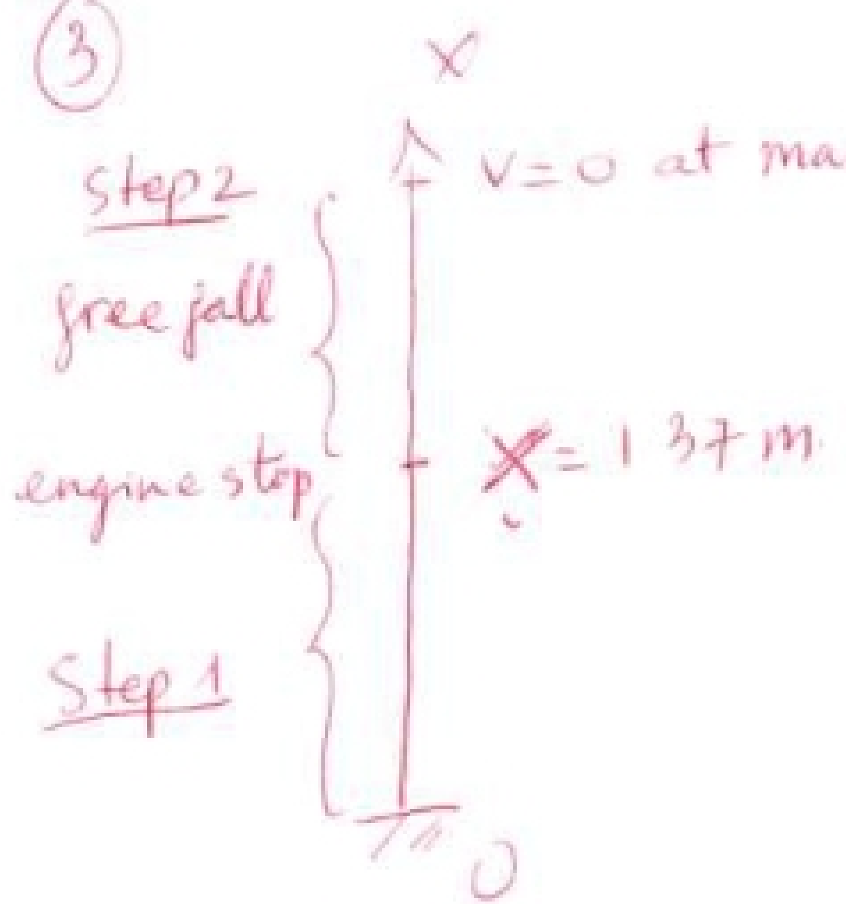
(b) $$v_y = v_{oy} - gt = 4.5\,m/s - (9.81\,m/s^2)(0.15s)$$

$$= 3.02\,m/s$$

(c) $$\Delta y = \frac{v_y^2 - v_{oy}^2}{-2g} = \frac{0 - (3.02\,m/s)^2}{(-2)(9.81\,m/s^2)}$$

$$= 0.467\,m$$

(3)



This motion is quite complicated since it has two steps : motion under the engine (step 1) and motion under free fall (step 2)

a) Maximum height

<u>Step 2</u> : $V^2 = V_0^2 - 2g\,\Delta x$

$$\Delta x = \frac{V^2 - V_0^2}{-2g}$$

Find V_0 from step 1

$$V^2 = V_0^2 + 2a\,\Delta x = 57.7\ m/s$$

$$\Delta x = \frac{0 - (57.7\ m/s)^2}{-2 \times 9.81\ m/s^2} = 170\ m$$

$$\Delta x = x - x_0 \Rightarrow x = \Delta x + x_0 = 170 + 137 = 307\ m$$

b) step 1 : $t_1 = \frac{v_f - v_i}{a} = \frac{57.7 m/s - 53.2 m/s}{1.81 m/s^2}$

$$t_2 = \frac{0 - v_i}{-g} = \frac{-57.7 m/s}{-9.81 m/s^2}$$

$$t = t_1 + t_2 = 8.36 s$$

c) when the rocket falls to the ground from the highest point

$$\underbrace{y - y_0}_{-h} = \underbrace{v_0}_{0} t_3 + \frac{1}{2} a t_3^2 \rightarrow t_3 = \sqrt{\frac{-2h}{a}} = \sqrt{\frac{-2h}{-g}} = \sqrt{\frac{2h}{g}}$$

$$= \sqrt{\frac{2(307 m)}{9.81 m/s^2}}$$

$$t_3 = 7.91 s$$

$$t = t_1 + t_2 + t_3 = 16.3 s$$

4 Please see the example in the class