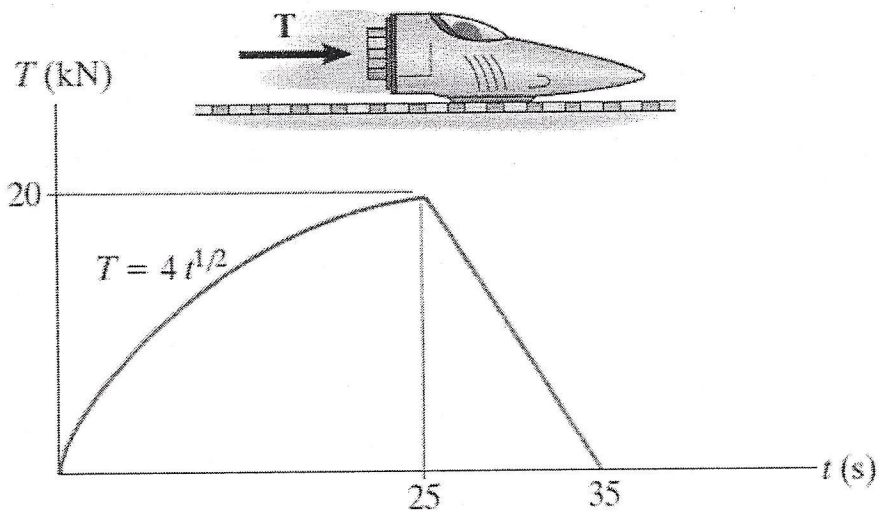
MAAE 2101 DYNAMICS – Class Quiz – 8% - L3 & L4 – Friday Oct. 13 – 2:30 to 3:30 am

Last Name: _____ *First Name:*_____ *LAB /PA* :_____

Important: The LAB session (L1, L2, …) is required (to get the marked assignment back by your TA

The thrust on the 4-Mg rocket sled is shown in the graph. Determine the sleds maximum velocity and the distance the sled travels when $t = 35$ s. Neglect friction.



C.O.M

$m\cancel{v_1}^{0} + \sum \int F\,dt = mv_2$

from $t=0 \to t=25$

$$\int_0^{25} 4t^{\frac{1}{2}}\,dt = mv_2 \rightarrow v_2 = \frac{\left(4\left(\frac{2}{3}\right)t^{\frac{3}{2}}\right)\Big|_0^{25}}{4} \Rightarrow v = \frac{2}{3}t^{\frac{3}{2}} \quad (1)$$

$$v_2 = \frac{2}{3}(25)^{\frac{3}{2}} = 83.33\ \frac{m}{s}$$

from $t=25 \to t=35$

$$\text{slope} = \frac{20-0}{25-35} = -2 \Rightarrow (-2)(t-35) = T-0 \Rightarrow T = -2t+70$$

$$mv_2 + \sum \int F\,dt = mv_3 \Rightarrow v_2 + \sum \int \frac{(-2t+70)}{4}\,dt = v_3$$

Eq. for velocity from 25s–35s

$$v_3 = 83.33 + \left(\frac{-t^2}{4} + 17.5t\right)\Big|_{25}^{35} \Rightarrow v = \int_{25}^{t}\left(-\frac{t}{2}+17.5\right)dt + 83.33 = -0.25t^2 + 17.5t - 197.92 \quad (2)$$

$$= 83.33 + \left(\frac{-(35)^2}{4} + 17.5(35)\right) - \left(\frac{-(25)^2}{4} + 17.5(25)\right) = \boxed{108.3\ \frac{m}{s}}$$

Distances

$v\,dt = dr$

from $t=0 \to t=25$

$$r = \int_0^{25} \frac{2}{3}t^{\frac{3}{2}}\,dt = \frac{4}{15}t^{\frac{5}{2}}\Big|_0^{25} = 833.33\text{m}$$

from $t=25 \to t=35$

$$r - \underbrace{833.33}_{\text{Int. Cond.}} = \int_{25}^{35}(-0.25t^2 + 17.5t - 197.92)\,dt$$

$$r = (-.0833t^3 + 8.75t^2 - 197.92t)\Big|_{25}^{35} + 833.33 = \boxed{1833\text{m}}$$