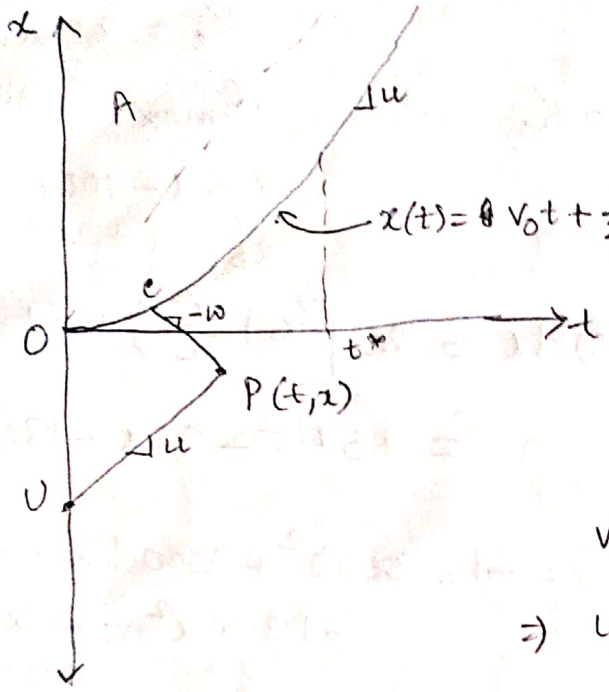
4.1.

$V_0 = 40$ Km/hr

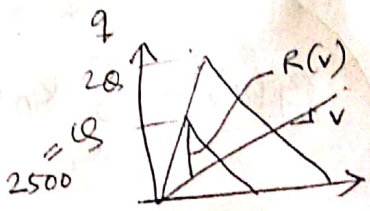
$a = 2 m/s^2$

$= 25920$ Km/hr$^2$

(b)




$x(t) = V_0 t + \frac{1}{2} a t^2 = 40t + 12960 t^2$




$V_0 t^* + a t^* = u$

$\Rightarrow 40 + 25920 t^* = 100$

$t^* = \frac{1}{432}$ hr.

$C(t_c, x_c)$

$$t_c = \frac{\sqrt{5}\sqrt{1440t + 72x + 5} - 5}{2160}$$

$$= \frac{\sqrt{1 + 14.4x + 288t} - 1}{432}$$

$$x_c = \frac{5}{108}\left(\sqrt{1 + 14.4x + 288t} + 432t + 21.6x + 1\right)$$

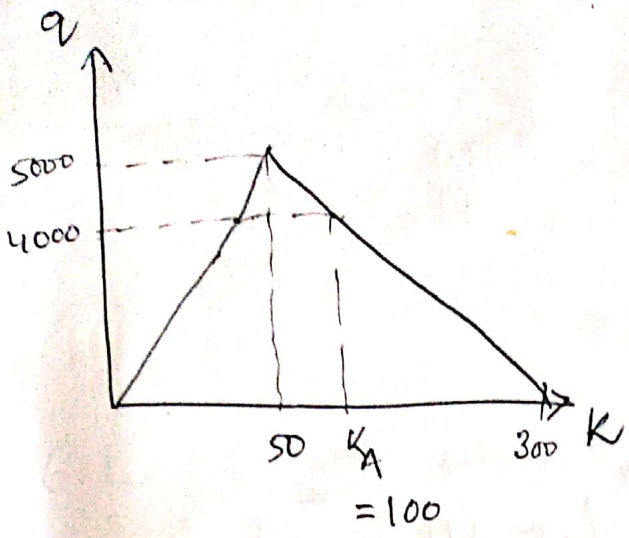
Cost P–C–O

= Cost P–C + Cost C–O

$$= K(x_c - x_p) + \int_0^{t_c} R(v(t))\,dt$$

$$= 300\left(\frac{5}{108}\right)\left(-\sqrt{1 + 14.4x + 288t} + 432t + 1\right) + \int_0^{t_c} Q\left(1 - \frac{V_0 + at}{u}\right)dt$$

$$= \frac{-25}{18}\left(\sqrt{5}\sqrt{1440t + 72x + 5} - 3960t + 18x - 5\right)$$




$= 100$

$$f(x_u) = K_A |x_u|$$

$$= 400 (ut - x) = 100 (100t - x)$$

$$N(t,x) = \min \{ \text{cost } P \to C \to 0, f(x_u) \}$$

$$N(t,x) = \min \left\{ \frac{-25}{18} \left( \sqrt{5} \sqrt{1440t + 72x + 5} - 3960t + 18x - 5 \right) , 100 (100t - x) \right\}$$

Trajectory of shock is given by :

$$\text{cost } P \to C \to 0 = f_u$$

$$\frac{-25}{18} \left( \sqrt{5} \sqrt{1440t + 72x + 5} - 3960t + 18x - 5 \right) = 100 (100t - x)$$

~~$2916x^2 - 349920xt + 1049760t^2 - 39600t + 180x = 0$~~

$$2916x^2 - 349920xt + 180x + 1049760t^2 - 39600t = 0$$

parabola trajectory for shock