7-86

- Assuming no work done against friction or gravity
- Given mass = M, power = P, $v_0 = 0$, Find speed & position as fxns of time

- $P = \frac{dW_{net}}{dt} \Rightarrow dW_{net} = P \cdot dt$

$W_{net} = \int P \cdot dt$ but Power is constantly applied by locomotive

$W_{net} = P \cdot \int_0^t dt$

$W_{net} = P \cdot (t - 0)$

$W_{net} = P \cdot t$

- $W_{net} = \Delta K$

$\Rightarrow P \cdot t = \frac{1}{2}Mv^2 - \frac{1}{2}Mv_0^2$

$P \cdot t = \frac{1}{2}Mv^2$

$\frac{2P \cdot t}{M} = v^2 \rightarrow v(t) = \sqrt{\frac{2Pt}{M}}$ Take positive root b/c speed. (Pull out constants if you like)

$v(t) = \left(\frac{2P}{M}\right)^{1/2} \cdot t^{1/2}$

- $v = \frac{dx}{dt}$

$\Rightarrow \frac{dx}{dt} = \left(\frac{2P}{M}\right)^{1/2} \cdot t^{1/2}$

$\int_{x_0}^{x} dx = \int_0^t \left(\frac{2P}{M}\right)^{1/2} t^{1/2}\, dt$

$x - x_0 = \left(\frac{2P}{M}\right)^{1/2} \int_0^t t^{1/2}\, dt$

Position of train $= x - x_0 = \left(\frac{2P}{M}\right)^{1/2} \cdot \frac{t^{3/2}}{3/2}\Big|_0^t = \frac{2}{3} \cdot \left(\frac{2P}{M}\right)^{1/2} \cdot t^{3/2}$