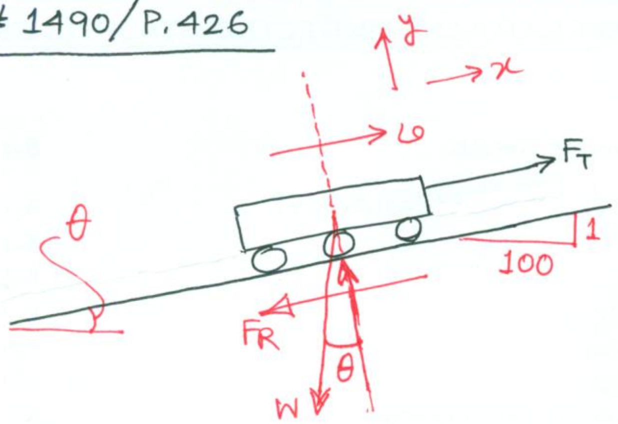
#1490/P.426



$F_T = 50,000$ lb

$W = 2000$ Ton $= 2000 \times 2000$ lb

$F_R = 15$ lb/Ton

$= 15 \times 2000$ lb

$v_0 = 60$ mph $= \frac{60 \times 1760 \times 3}{60 \times 60}$ fps

$= 88$ fps

(a) for $s = 2$ mile, $v_{top} = ?$

max^m hp of drawbar = ?

hp of drawbar at top = ?

(b) for $s = 4$ mile, $v_{top} = ?$

Sol^n (a) Considering $\Sigma F_x = m a_x$

$$\Rightarrow F_T - F_R - W \sin\theta = \frac{W}{g} \cdot a$$

$$\Rightarrow 50000 - 15 \times 2000 - 2000 \times 2000 \times \frac{1}{\sqrt{100^2 + 1^2}} = \frac{2000 \times 2000}{32.2} \times a$$

$\therefore a = -0.161$ fps^2, –ve sign indicates retardation

$$v_{top}^2 = v_0^2 + 2as = 88^2 + 2 \times (-0.161) \times (2 \times 1760 \times 3)$$

$$\therefore v_{top} = 65.9 \text{ fps} = \frac{65.90 \times 60 \times 60}{1760 \times 3} \text{ mph} = \boxed{44.93 \text{ mph}}$$

Max^m power is delivered when the velocity is maximum.

$$\therefore \text{Max}^m \text{ h.p.} = \frac{F_T \cdot v_0}{550} = \frac{50000 \times 88}{550} = \boxed{8000}$$

[P.411/Eq^n for h.p. 1 hp = 550 ft-lb/sec.]

h.p. when the train is at the top

$$= \frac{F_T \cdot v_{top}}{550} = \frac{50000 \times 65.9}{550} = \boxed{5991}$$

(b) for $s = 4$ mile

$$v_{top}^2 = v_0^2 + 2as = 88^2 + 2 \times (-0.161) \times (4 \times 1760 \times 3)$$

$$\therefore v_{top} = 30.71 \text{ fps} = \frac{30.71 \times 60 \times 60}{1760 \times 3} \text{ mph} = \boxed{20.94 \text{ mph}}$$