

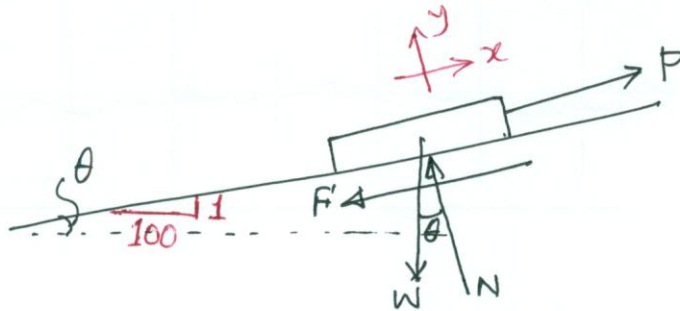
# 1126/P. 326

Train moving up  $1\%$  gradeLocomotive pull,  $P = 60,000$  lbResistance,  $F = 15$  lb/ton

$$v_0 = 5 \text{ mph} = \frac{5 \times 1760 \times 3}{60 \times 60} \text{ fps} = 7.33 \text{ fps}$$

$$v_f = 30 \text{ mph} = \frac{30 \times 1760 \times 3}{60 \times 60} \text{ fps} = 44 \text{ fps}$$

$$S = 8 \text{ miles} = 8 \times 1760 \times 3 \text{ ft}$$

Weight of train,  $W = ?$ Sol<sup>n</sup>

$$v_f^2 = v_0^2 + 2aS$$

$$\Rightarrow 44^2 = 7.33^2 + 2 \times a \times (8 \times 1760 \times 3)$$

$$\therefore a = 0.0222 \text{ fps}^2$$

Now Taking  $\Sigma F_x = ma$ , +ve x direction +ve

$$P - W \sin \theta - F = \frac{W}{g} \cdot a$$

$$\Rightarrow 60000 - W \times \frac{1}{\sqrt{100^2 + 1^2}} - \frac{W}{2000} \times 15 = \frac{W}{32.2} \times 0.0222$$

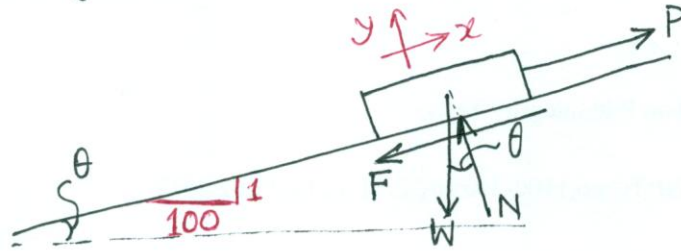
$$\Rightarrow W = \left[ \frac{0.0222}{32.2} + \frac{15}{2000} + \frac{1}{\sqrt{10001}} \right] = 60000$$

$$\therefore W = 3298707.71 \text{ lb}$$

$$= 1649.36 \text{ ton}$$

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Train moving up 1% grade

Locomotive pull,  $P = 60,000$  lbResistance,  $F = 15$  lb/ton $v_0 = 5$  mph,  $v_f = 30$  mph $s = 8$  milesWeight of train,  $W = ?$ Sol<sup>n</sup>

$$v_f^2 = v_0^2 + 2as$$

$$\Rightarrow 30^2 = 5^2 + 2 \times a \times 8$$

$$\therefore a = 54.69 \text{ mph}^2 = \frac{54.69 \times 1760 \times 3}{(60 \times 60)^2} \text{ fps}^2 = 0.0222 \text{ fps}^2$$

Applying  $\Sigma F_x = ma$ , +ve x direct<sup>n</sup> +ve

$$P - W \sin \theta - F = \frac{W}{g} a \quad [\text{Consider } W \text{ in ton}]$$

$$\Rightarrow \frac{60000}{2000} - W \times \frac{1}{\sqrt{1^2 + 100^2}} - W \times 15 = \frac{W}{32.2} \times 0.0222$$

$$\Rightarrow W \left[ \frac{0.0222}{32.2} + \frac{15}{2000} + \frac{1}{\sqrt{10001}} \right] = \frac{60,000}{2000}$$

$$\therefore W = \boxed{1649.36 \text{ ton}} \quad \text{Ans.}$$