Answer on Question#53383 - Physics - Mechanics - Kinematics - Dynamics

A lorry, of mass $m = 38000\ \text{kg}$, starts up a hill of gradient 1 in 12. The constant acceleration is $a = 0.06\frac{\text{m}}{\text{s}^2}$ and resistance to motion is $F_r = 1200\ \text{N}$ (not gravitational force). What is the tractive force F in Newton's exerted by the lorry's driving wheels?

Solution:

According to the Newton's second law we obtain

$$ma = F - (F_r + mg\sin\phi),$$

where $g = 10\frac{\text{m}}{\text{s}^2}$ – acceleration due to gravity, and ϕ – is the angle of the incline. It's given that $\tan\phi = \frac{1}{12}$, or equivalently $\cot\phi = 12$. Since

$$\sin\phi = \frac{1}{\sqrt{1+\cot^2\phi}},$$

we obtain

$$ma = F - \left(F_r + \frac{mg}{\sqrt{1+\cot^2\phi}}\right)$$

$$F = ma + F_r + \frac{mg}{\sqrt{1+\cot^2\phi}} = 38000\ \text{kg}\cdot 0.06\frac{\text{m}}{\text{s}^2} + 1200\ \text{N} + \frac{38000\ \text{kg}\cdot 10\frac{\text{m}}{\text{s}^2}}{\sqrt{1+144}} =$$

$$= 35037\ \text{N}$$

Answer: $35037\ \text{N}$.