Answer on Question #69143 – Physics / Mechanics | Relativity

Question. A railway truck has a mass of 6 tons and is at rest on an incline of 1 in 30. The brakes are released and the truck runs down the incline. If the frictional resistance to motion is 300 N/t when it reaches the bottom of the incline using the principle of conservation of energy, calculate the velocity of the truck at the bottom of the incline, after travelling 20 m.

Solution.

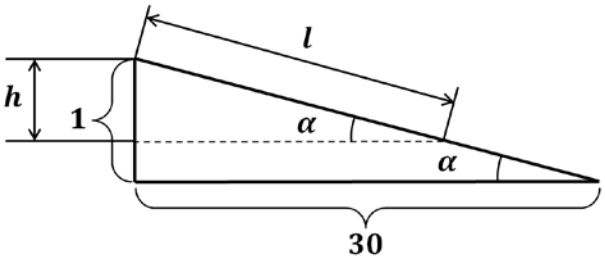

Fig.

$l = 20\ m;$

$m = 6\ ton = 6000\ kg;$

$f = 300\ \frac{N}{t} = 0{,}3\ \frac{N}{kg}.$

According to the principle of conservation of energy

$$mgh = \frac{mv^2}{2} + A_{fr} \Rightarrow mgh - A_{fr} = \frac{mv^2}{2} \Rightarrow v^2 = \frac{2(mgh - A_{fr})}{m} \Rightarrow v = \sqrt{2\left(gh - \frac{A_{fr}}{m}\right)}.$$

where A_{fr} – work of friction forces.

$$A_{fr} = F_{fr} \cdot l = f \cdot m \cdot l.$$

$$v = \sqrt{2\left(gh - \frac{f \cdot m \cdot l}{m}\right)} = \sqrt{2(gh - f \cdot l)}$$

From the fig.

$$\operatorname{tg}\alpha = \frac{1}{30};\ \alpha = \operatorname{acr\,tg}\left(\frac{1}{30}\right) = 1{,}909°.$$

$$h = l \cdot \sin\alpha.$$

$$v = \sqrt{2(g \cdot l \cdot \sin\alpha - f \cdot l)} = \sqrt{2l(g \cdot \sin\alpha - f)} = \sqrt{2 \cdot 20 \cdot (9{,}81 \cdot \sin(1{,}909) - 0{,}3)} = 1{,}035\ \frac{m}{s}.$$

Answer: velocity $v = \sqrt{2l(g \cdot \sin\alpha - f)} = 1{,}035\ \frac{m}{s}$.