Answer on Question #39827 – Physics – Mechanics

1. A 2400 W engine pulls a 200 kg block at constant speed up a 12.0 m long, 25.0^0 incline. Determine long does it takes to cover this distance.

$P = 2400 W$ $m = 200 kg$ $l = 12 m$ $\alpha = 25^0$	*Solution.*
$t - ?$	Let write down the equation of the motion of the body (Newton second law) onto the *X*- and *Y*-axes (*X*-axis is directed along the plane and *Y*-axis goes in the perpendicular direction):

$$m\vec{a} = m\vec{g} + \vec{N} + \vec{F},$$

where $\vec{F}$ is the pulling force. At the constant speed, the power of the engine is $P = F \cdot v$.

As the velocity of the block is constant, the acceleration equals to zero.

Then, write down this law in projectives:

$$\begin{cases} m \cdot 0 = mg\sin\alpha - F \\ m \cdot 0 = -mg\cos\alpha + N \end{cases},$$

so the pulling force is $F = mg\sin\alpha$.

We can find the time of the motion of the block with the constant velocity:

$$t = \frac{l}{v} = l : \frac{P}{F}, \quad \boxed{t = \frac{lmg\sin\alpha}{P}}.$$

Let check the dimension.

$$[t] = \frac{m \cdot kg \cdot \frac{m}{s^2}}{W} = \frac{m \cdot N}{J/s} = s.$$

Let evaluate the quantity.

$$t = \frac{12 \cdot 200 \cdot 9.8 \cdot \sin 25^0}{2400} = 4.14(s).$$

Answer: 4.14 s.