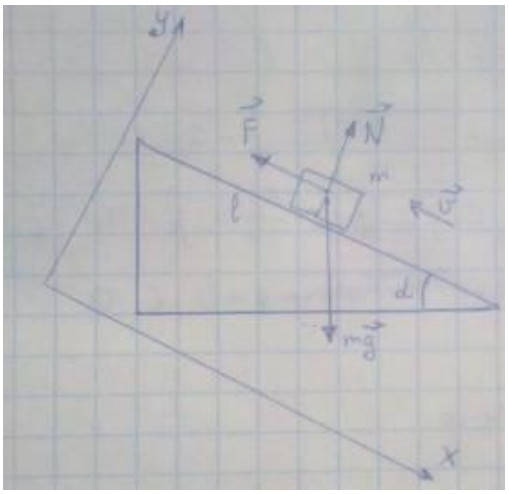
Answer on Question #40095 – Physics – Mechanics

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.

$P = 2400 W$
$m = 200 kg$
$l = 12 m$
$\alpha = 25^0$
$t - ?$

Solution.



Let write down the equation of the motion of the body (Newton second law):

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

where $\vec{F}$ is the pulling force.

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

Then, write down this law in projectives onto the *X*- and *Y*-axes:

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

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

At the constant speed, the power of the engine is $P = F \cdot v$.

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.