Answer on Question #47254 – Physics – Other

Question.

A person has to pull a large rock up a hill. The rock has a mass of 2.00 x 10^2 kg and the person drags it up an incline of 5 degrees. There is a coefficient of kinetic friction of 0.600 between the rock and the ground. If the person is dragging it upwards at a constant velocity, what is the tension of the rope between the person and the rock?

Given:

$m = 200\ kg$

$\theta = 5°$

$\mu = 0.6$

$v = const$

Find:

$T = ?$

Solution.

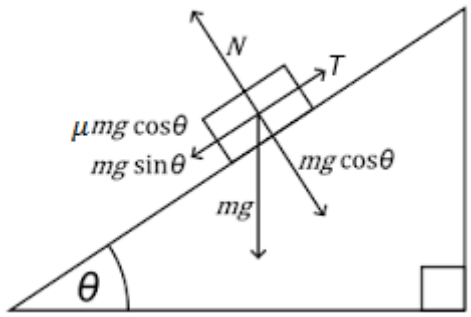

Fig. 1. The force diagram.

Let remember the second Newton's law:

$$\sum \vec{F} = ma$$

But in our case we have the constant velocity $\rightarrow a = 0$. So, we have $\sum \vec{F} = 0$

We have 3 forces acting on the rock: the gravity force, the kinetic friction force and the tension of the rope. Therefore,

$$\vec{F}_{gr} + \vec{F}_{fr} + \vec{T} = 0$$

Let project all acting forces on the selected axis of motion:

$$T = T$$

$$F_{gr} = -mg\sin\theta\,;$$

$$F_{fr} = -\mu N = -\mu mg\cos\theta$$

Finally, we received:

$$T - mg\sin\theta - \mu mg\cos\theta = 0$$

$$T = mg\sin\theta + \mu mg\cos\theta = mg(\sin\theta + \mu\cos\theta)$$

Calculate:

$$T = 200 \cdot 9.8 \cdot (\sin 5° + 0.6 \cdot \cos 5°) = 1960 \cdot (0.087 + 0.598) = 1342.6\ N$$

Answer.

$T = mg(\sin\theta + \mu\cos\theta) = 1342.6\ N$