Phys 131 2025

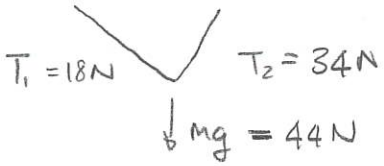
Lecture 17

Mon: Warm Up

Tues: Discussion / quiz

189, 194, 195, 197, 199, 205, 208

Group Ex Solutions – on D2L



Note $T_1 + T_2 \neq mg$

because $18N + 34N \neq 44N$

Quiz 1 95%

Quiz 2 75% – 90%

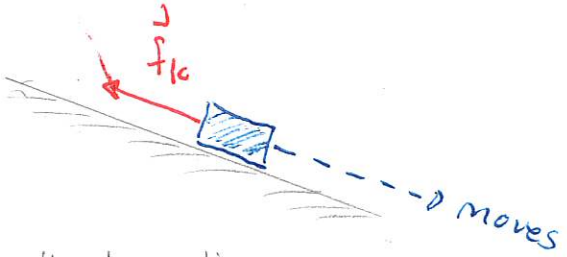
Friction

Friction is a force exerted by one surface on another that tends to oppose motion. We will consider two types of friction

* kinetic friction ~ surfaces slide relative to each other
* static friction ~ surfaces are fixed relative to each other

Kinetic friction

This occurs when one surface moves along the other. This force is denoted $\vec{f}_k$ and has properties



* direction parallel to surface and opposite to motion
* magnitude $f_k = \mu_k n$

where n = normal force

μ_k = coefficient of friction → depends on materials of the surfaces Table 6.1

Quiz 3 50% — 75%

~~Quiz 4~~ Quiz 5 :

Note that

$f_k = \mu_k n$

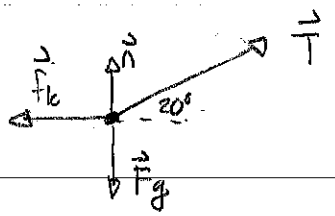
↳ can vary depending on circumstances

only depends on materials

192 Dynamics of a single object with friction, 2

A 15.0 kg box moves rightward along a horizontal surface. A rope pulls with a force at the illustrated angle. The coefficient of kinetic friction is 0.350. Use *all of the steps of Newton's Second Law* to determine the acceleration of the box. *(131Sp2025)*

Answer: (1) FBD



(2) Newton's 2nd Law

$\Sigma F_{ix} = ma_x$

$\Sigma F_{iy} = ma_y = 0$

(3) Components

$F_g = mg = 15.0\text{kg} \times 9.8\text{m/s}^2 = 147\text{N}$

$f_k = \mu_k n$

$T_{1x} = T_1 \cos 20^\circ = 85\text{N} \cos 20^\circ = 79.9\text{N}$

$T_{1y} = T_1 \sin 20^\circ = 85\text{N} \sin 20^\circ = 29.1\text{N}$

	x	y
$\vec{F}_g$	0	−147N
$\vec{n}$	0	n
$\vec{T}$	79.9N	29.1N
f_k	$-\mu_k n$	0

(4) Substitute into Newton's 2nd Law

$\Sigma F_{ix} = ma_x \Rightarrow 79.9\text{N} - \mu_k n = ma_x$

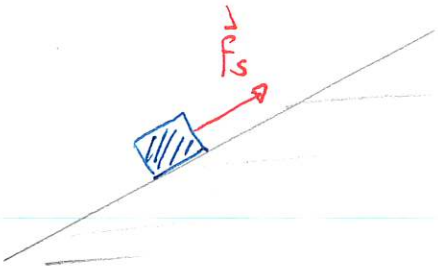
$\Rightarrow$ (79.9N − 0.350n = 15.0kg a_x)

$\Sigma F_{iy} = 0 \Rightarrow$ (−147N + n + 29.1N = 0) $\Rightarrow n = 118\text{N}$

Then $79.9\text{N} - 0.350 \times 118\text{N} = 15.0\text{kg}\, a_x$

$\Rightarrow 38.6\text{N} = 15.0\text{kg}\, a_x \Rightarrow a_x = \dfrac{38.6\text{N}}{15.0\text{kg}} \Rightarrow a_x = 2.57\text{m/s}^2$

Static friction



Static friction occurs when the surfaces do not slide relative to each other but would in the absence of friction. This is denoted $\vec{f}_s$ and has properties:

* direction = parallel to surface and opposite to motion that would occur
* magnitude = adjustable up to a maximum

$$f_{s\,max} = \mu_s n$$

where μ_s is the coefficient of static friction (depends on surfaces)

So $$f_s \leq \mu_s n$$

Quiz ~~5~~ 4: 30%

Quiz 6