Phys 131 2024

Review 2

Thurs: Seminar 12:30 Wubben 203

Fri: Exam 2

* Covers: - Ch 5, 6, 7, 8
  - Lectures 12 – 22
  - HW 5-7 Discussions 5-7
* Bring: - Calculator (no communication!)
  - Second 3" x 5" single side card plus original card
* Study - Fall 22, Spring 23 } Class exam II – all questions
  - HW
  - Discussion probs
  - Quizzes
  - Conceptests
* 10am Section – Remain in Class Until 10:50am

Formulae: Know – Newton's 1st, 2nd, 3rd Laws
– forces ⇒ acceleration

$\vec{F}_{net} = m\vec{a}$

$\sum F_{ix} = ma_x$

$\sum F_{iy} = ma_y$

$F_g = mg$

$f_k = \mu_k n$

$f_s \leq \mu_s n$

$v = \omega r$

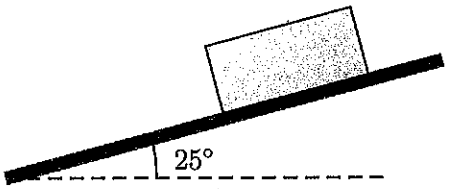
$a = v^2/r = \omega^2 r$

uniform circular motion $\vec{a}$, $\vec{F}_{net}$ radially inward

Quiz 1 80%-95% } 80%

200 Crate sliding along a rough ramp

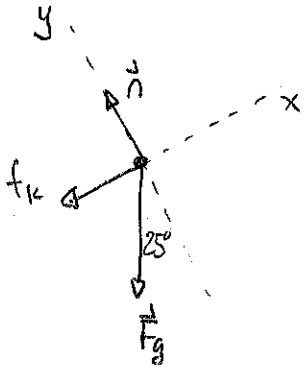
A 15 kg crate can slide up or down a ramp at angle 25° from the horizontal. The coefficient of kinetic friction between the crate and the ramp is 0.30. *(131F2024)*



a) Determine the crate's acceleration if it slides up the ramp.

b) Determine the crate's acceleration if it slides down the ramp.

Answer: a)



$\Sigma F_{ix} = ma_x = ma$

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

} tilted axes.

$F_g = mg \qquad f_k = \mu_k n$

Components

	x	y
$\vec{F}_g$	$-mg\sin 25°$	$-mg\cos 25°$
$\vec{n}$	0	n
$\vec{f}_k$	$-\mu_k n$	0

$\Sigma F_{ix} = ma \Rightarrow$ $-mg\sin 25° - \mu_k n = ma$

$\Sigma F_{iy} = 0 \Rightarrow -mg\cos 25° + n = 0$

$\Rightarrow n = mg\cos 25°$

Combine circled $\Rightarrow$

$-mg\sin 25° - \mu_k mg\cos 25° = ma$

$\Rightarrow a = -g[\sin 25° + \mu_k \cos 25°]$

$= -9.80 m/s^2[\sin 25° + 0.30\cos 25°] = -6.8 m/s^2$

b) The difference is that $\vec{f}_k$ points up the ramp

$\Rightarrow -mg\sin 25° + \mu_k n = ma$

$\Rightarrow -mg\sin 25° + \mu_k mg\cos 25° = ma$

$\Rightarrow a = -g[\sin 25° - \mu_k \cos 25°] =$

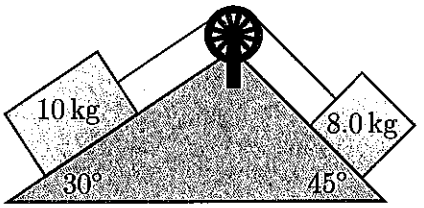
$= -9.8 m/s^2[\sin 25° - 0.30\cos 25°] = -1.5 m/s^2$

Quiz2 30% – 40% } 20% – 90%

Quiz3 30% – 80% } 30% – 90%

231 Connected objects: two ramps

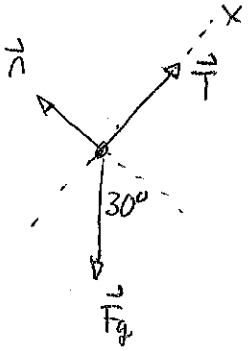
Blocks connected by a massless string are able to slide on two frictionless ramps. *(131F2024)*



a) Determine the acceleration of the blocks.

b) Suppose that the block on the right were replaced by another block so that the two blocks slide with constant speed. What would the mass of the block on the right be?

a) 10kg block (call this 1



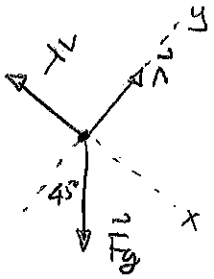
$\Sigma F_{ix} = m_1 a_{1x}$

$\Sigma F_{iy} = m_1 a_{1y} = 0$

	x	y
$\vec{T}$	T	0
$\vec{n}$	0	n
$\vec{F}_g$	$-mg\sin 30^\circ$	$-mg\cos 30^\circ$

$\Sigma F_{ix} = m_1 a_{1x} \Rightarrow T - m_1 g \sin 30^\circ = m_1 a_{1x}$

8.0kg block (call this 2)



$\Sigma F_{ix} = m_2 a_{2x}$

$\Sigma F_{iy} = m_2 a_{2y} = 0$

	x	y
$\vec{T}$	$-T$	0
$\vec{n}$	0	n
$\vec{F}_g$	$m_2 g \sin 45^\circ$	$-m_2 g \cos 45^\circ$

$\Sigma F_{ix} = m_2 a_{2x}$

$\Rightarrow -T + m_2 g \sin 45^\circ = m_2 a_{2x}$

Relate accelerations $a_{2x} = a_{1x}$

$$\left.\begin{aligned} T - m_1 g \sin 30^\circ &= m_1 a_{1x} \\ -T + m_2 g \sin 45^\circ &= m_2 a_{1x} \end{aligned}\right\} \text{ADD} \Rightarrow m_2 g \sin 45^\circ - m_1 g \sin 30^\circ = (m_1 + m_2) a_{1x}$$

$$\Rightarrow \frac{g(m_2 \sin 45^\circ - m_1 \sin 30^\circ)}{m_1 + m_2} = a_{1x}$$

$$\Rightarrow a_{1x} = 9.8\,m/s^2 \frac{(8.0kg \sin 45^\circ - 10kg \sin 30^\circ)}{18kg}$$

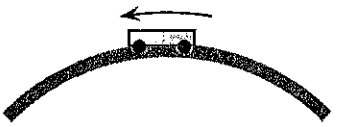
$$= 0.36\,m/s^2$$

Quiz 4 90% //90%

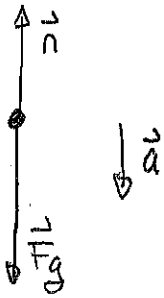
Quiz 5 75% - 80% //90%

249 Cart sliding over a hill

A 30 kg cart slides over a hill, which has a circular cross-section of radius 12 m. The speed of the cart at the highest point is 4.0 m/s. Determine the normal force exerted by the hill on the cart. *(131F2024)*



Ans:



$a_c = v^2/r$

$\Sigma F_{iy} = ma_y$

$n - mg = ma_y$

$= -mv^2/r$

$\Rightarrow n = mg - mv^2/r$

$\Rightarrow n = m[g - v^2/r]$

$\Rightarrow n = 30\text{kg}\left[9.8\text{m/s}^2 - \frac{(4.0\text{m/s})^2}{12\text{m}}\right]$

$= 254\text{N}$

The gravitational force on the car is $mg = 30 \times 9.8\text{m/s}^2 = 294\text{N}$.

The normal force is thus less.