Phys 131 2023

Review 2

Thurs: Seminar 12:30 - 1:30 WS 203

Fri: Exam II

* Covers: Ch 5, 6
  Lectures 12-23 (Dynamics)
  HW 5-7 Discussions 4-6

* Bring: - Calculator (no communicating device!)
  - Original notecard: single side 3" x 5"
  - Second " " " 3" x 5"

* Study - 2018, 2022 Exam 2
  - HW, Discussion questions
  - Quizzes, Group exercises
  - Class multiple choice texts.

* Early Section - Remain in class until 10:50am

Ch 5.1 → 5.7

Ch 6.1 → 6.3

Know: * Forces ⇒ acceleration
  * Newton's 1st, 2nd, 3rd Laws

$\vec{F}_{net} = m\vec{a}$ $F_g = mg$ $v = \omega r$

$\sum F_x = ma_x$ $f_k = \mu_k n$ $a = v^2/r = \omega^2 r$

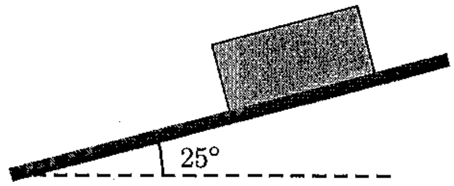
$\sum F_y = ma_y$ $f_s \le \mu_s n = f_{s\,max}$

For unif circular motion, net force radially in

Quiz 1 80% ~ 90% ≥ 90% -

152 Crate sliding along a rough ramp

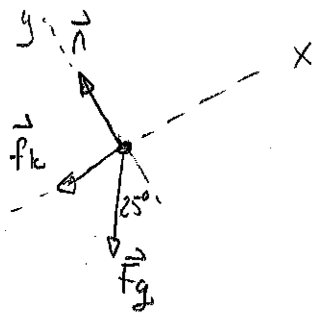
A 15 kg crate can slide up or down a ramp at angle 25° from the horizontal. The coefficient of kinetic friction between the crate and the ramp is 0.30. *(131Sp2023)*



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)



$$\sum F_x = m a_x$$

$$\sum F_y = m a_y = 0$$

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

Components

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

$$\sum F_y = 0 \Rightarrow -mg\cos 25° + n = 0$$

$$\Rightarrow n = mg\cos 25°$$

$$\sum F_x = ma_x \Rightarrow -mg\sin 25° - \mu_k n = m a_x$$

$$\Rightarrow -mg\sin 25° - \mu_k mg\cos 25° = ma_x$$

$$\Rightarrow a_x = -g\left[\sin 25° + \mu_k\cos 25°\right]$$

$$= -9.8\,\text{m/s}^2\left[\sin 25° + 0.30\cos 25°\right]$$

$$= -6.8\,\text{m/s}^2$$

b) The only difference is that the x-component of f_k is $+\mu_k n$. Thus

$$\sum F_x = ma_x \Rightarrow -mg\sin 25° + \mu_k n = ma_x$$

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

$$\Rightarrow a_x = g\left[\mu_k\cos 25° - \sin 25°\right]$$

$$= 9.8\,\text{m/s}^2\left[0.30\cos 25° - \sin 25°\right]$$

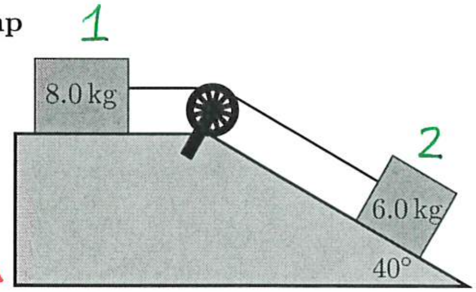
$$= -1.5\,\text{m/s}^2$$

Quiz2 70% → 85% { 80% - 90%

Quiz3 95% { 70% -

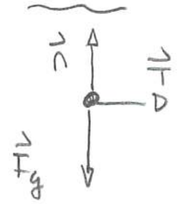
179 Connected objects: horizontal and a rough ramp

Blocks connected by a massless string are able to slide on the illustrated surfaces. The strings run parallel to the surfaces. The horizontal surface is frictionless and the ramp has coefficient of kinetic friction 0.50. Determine the acceleration of the block on the ramp. *(131Sp2023)* if it descends



Answer: Block 1

mass m_1

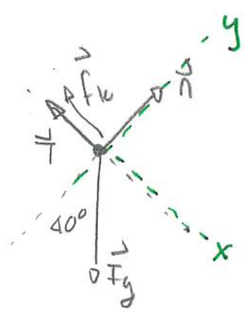


$$\sum F_x = m_1 a_x$$

$$\Rightarrow \boxed{T = m_1 a_x} \quad -(1)$$

Block 2

mass m_2



$$\sum F_x = m_2 a_x$$

$$\sum F_y = m_2 a_y = 0$$

$$F_g = m_2 g$$

$$f_k = \mu_k n$$

	x	y
$\vec{n}$	0	n
$\vec{T}$	$-T$	0
$\vec{f}_k$	$-\mu_k n$	0
$\vec{F}_g$	$m_2 g \sin 40°$	$-m_2 g \cos 40°$

Then $\sum F_y = 0 \Rightarrow n - m_2 g \cos 40° = 0$

$$\Rightarrow \boxed{n = m_2 g \cos 40°} \quad (2)$$

$$\sum F_y = m_2 a_x \Rightarrow \boxed{-T - \mu_k n + m_2 g \sin 40° = m_2 a_x} \quad -(3)$$

Combining (1), (2) (3) gives $-m_1 a_x - \mu_k m_2 g \cos 40° + m_2 g \sin 40° = m_2 a_x$

$$\Rightarrow -\mu_k m_2 g \cos 40° + m_2 g \sin 40° = m_1 a_x + m_2 a_x = (m_1 + m_2) a_x$$

$$\Rightarrow a_x = \frac{m_2 g [\sin 40° - \mu_k \cos 40°]}{m_1 + m_2} = \frac{6.0\,\text{kg} \times 9.8\,\text{m/s}^2 [\sin 40° - 0.50 \cos 40°]}{14.0\,\text{kg}}$$

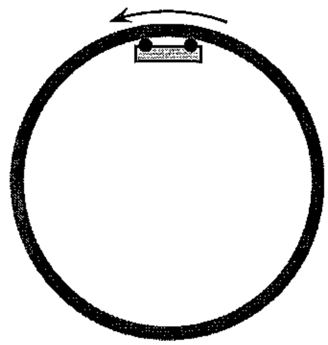
$$\Rightarrow a_x = 1.1\,\text{m/s}^2$$

Quiz 4 70% - 95% ≥ 95%

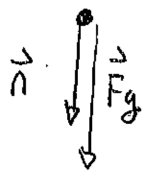
Quiz 5 60% - 70% ≥ 70%

195 Roller coaster inside a circular loop

Two identical roller coasters cars, A and B, each move along a track that makes a vertically oriented circle with radius R. Each passes along the inside of the track at the top and is in contact with the track at this point. The speed of A is larger than the speed of B. Determine whether the normal force on A is the same as, smaller than or larger than the normal force on B. *(131Sp2023)*



Answer:



$$\sum F_y = m a_y$$

The acceleration is radially inward. So

$$a_y = -\frac{v^2}{R}$$

$$\Rightarrow \quad -n - mg = -m\frac{v^2}{R} \quad \Rightarrow \quad n + mg = m\frac{v^2}{R}$$

$$\Rightarrow \quad n = m\left[\frac{v^2}{R} - g\right]$$

For larger v this is larger. Thus larger normal force for A