SI P121 Final Exam Summary Session S24

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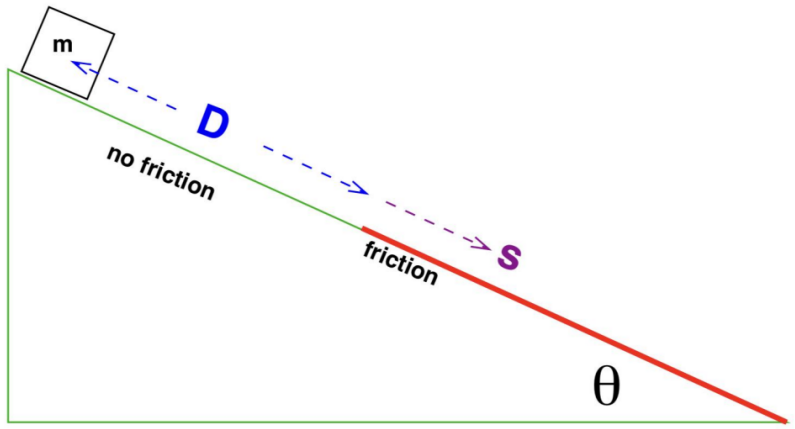
Learning Objectives

By the end of this session, students will be able to:

- Draw accurate and complete FBDs and XFBDs and apply N2L
- Recall the conditions for CofME, CofLM, and CofAM and apply them
- Find position, velocity, and acceleration using (translational/rotational) Kinematics
- Physics :)

Question 1- Let's Ramp Things Up!



A block of given mass m is placed on a fixed ramp as shown above. The angle of the ramp relative to the horizontal is given as θ. The block is released from rest at the top of the ramp and then is allowed to slide down the ramp. The top section of the ramp (with given distance D) is frictionless. After the frictionless

section there is a section of the ramp with a known coefficient of kinetic friction μ. The block continues to slide down the ramp until it comes to a stop.

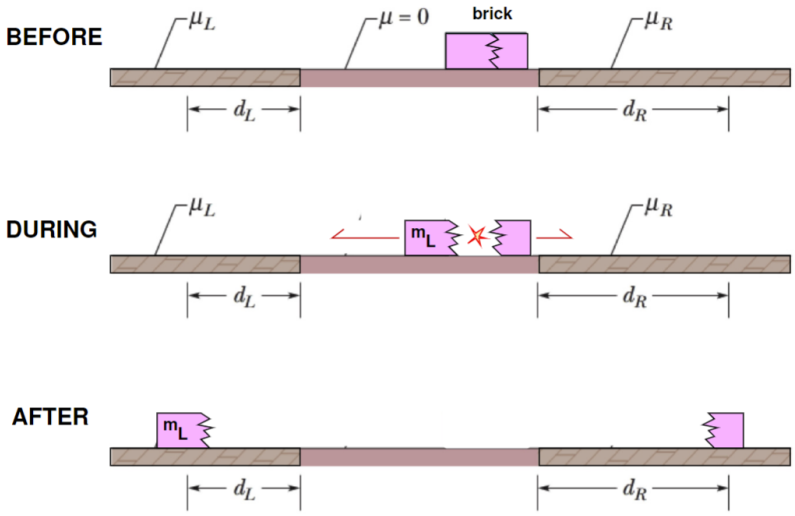
a. Immediately after the block is released at the top of the ramp, what is the magnitude of acceleration, a?

b. Calculate the speed of the block after it has travelled a distance D. This will also be the speed of the block the instant it hits the non-frictionless section of the ramp.

c. Calculate the distance s that the block slides past the boundary before coming to a stop.

d. Suppose that the block is not a block at all but is in fact a box containing Darth Vader. The combined mass of the box and Darth Vader is equal to m, and the mass of Darth Vader is equal to M_D. Find the effective weight of Darth Vader right before the box comes to a stop. Express it as a vector with the correct unit vector notation.

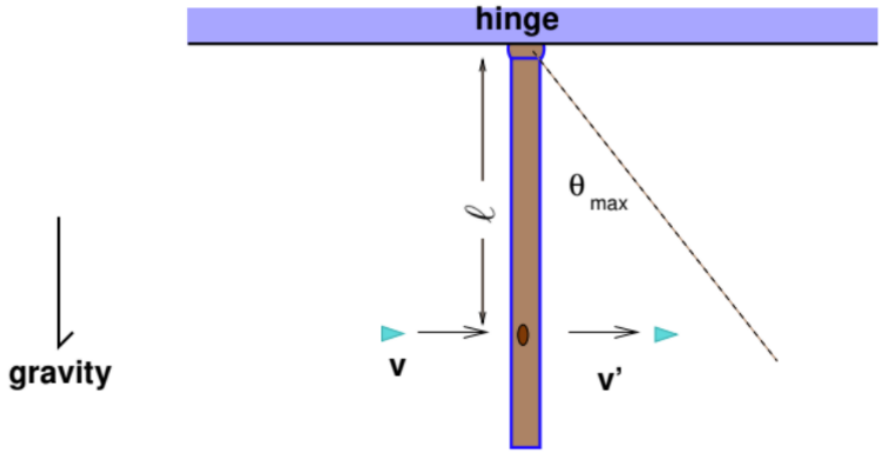
Question 2



An explosive charge is placed inside a brick which starts at rest on a table. The brick explodes horizontally into just two fragments. The left fragment has a given mass m_L and moves left and eventually encounters a surface region with a given coefficient of kinetic friction μ_L. The left fragment comes to rest in this after sliding a given distance d_L. The right fragment likewise encounters a region with a given coefficient of kinetic friction μ_r and eventually comes to rest after sliding a given distance d_r.

What was the **total mass** M of the original brick? Give your answer in terms of the given parameters of the problem. **Important**: Note that the mass of the **right** fragment is **not** a given parameter in this problem. Explain your work.

Question 3



A thin rod of given mass M and given length L hangs vertically from the ceiling attached to an ideal hinge. A unit of blaster fire which miraculously behaves exactly like a bullet of given mass m strikes the rod horizontally at a given point l from the hinge. The ~~bullet~~ unit of blaster fire pokes a small hole right through the rod. The speed of the *blaster fire* before the impact is given as v and the speed after the impact is given as v'. What is θ corresponding to the maximum swing angle of the rod after impact? Ignore any effect of gravity on the bullet.

Good luck on Tuesday! If you have any additional questions, feel free to reach out via email. Thanks for the great semester everyone!


IT'S CORBIN TIME
BOTTOM TEXT