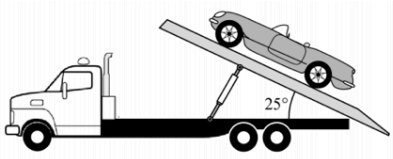
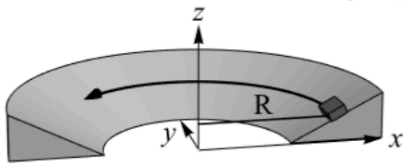
[I] A flatbed wrecker is hauling a car, travelling west at a constant speed $v_o = 16$ m/s. Due to an engineering flaw, the hydraulics engage while the truck is in motion, tilting the flatbed up to an angle $\theta = 25°$ above the horizontal. To make matters worse, the straps anchoring the car to the flatbed have sheared off, leaving only friction to hold the car on the wrecker! The friction coefficients between the wheels and the bed are $\mu_s = 0.67$ and $\mu_k = 0.40$.



(A) *(10 points)* Draw a free body diagram <u>for the car</u>, which does not slip as the wrecker continues moving at speed v_o. Use Newton's laws to determine the friction force acting on the car. Express your answer as a multiple of mg, the gravitational force on the car. <u>You will be graded on the quality of your diagram as much as the validity of your final answer!</u>

(B) *(10 points)* The driver of the wrecker realizes his predicament, and quickly brakes to a stop. Determine the maximum braking acceleration that the wrecker have without allowing the car to slip forward and launch itself off the inclined truck bed? Draw a new free-body diagram <u>for the car</u> as it accelerates to a stop along with the truck. Be sure to draw the acceleration vector for the car, because it will impact how you use Newton's laws to find a_{max}.

III. (16 points) There is a turn on the road (of radius R) out to Sweetwater Creek State Park that was designed for traffic traveling at the speed limit, but most people take it faster. When it rains, this causes a lot of accidents because the coefficient of static friction μ_s between rubber and asphalt decreases when wet. The highway engineers want to minimize accidents, so they they change the bank of the curve to an angle θ from the horizontal. What is the maximum speed at which a vehicle could safely make it around the curve with wet asphalt? Express your answer in terms of parameters defined in the problem, and physical or mathematical constants. (*On Earth.*)



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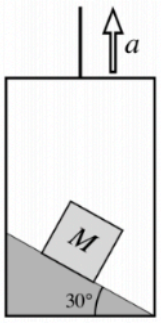
The following problem will be hand-graded. <u>Show all your work for this problem</u>. Make no marks and leave no space on your answer card for it.

[III] A block of mass $M = 12$ kg rests on a *slanted* elevator floor that makes an angle of 30° below the horizontal. The coefficient of static friction between the block and floor of $\mu_s = 0.75$. When the elevator is accelerating upward with a magnitude $a = 1.5$ m/s^2, the block does not slip along the floor.

In this problem, it will be advantageous to choose coordinate axes based on the <u>acceleration vector</u>, not the slanted floor!



(A) *(8 points)* What is the friction force acting on the block?

(B) *(12 points)* What is the <u>apparent weight</u> of the block as it accelerates upward? (That is, what is the perpendicular force that a spring scaled placed beneath the block would register?)