TEST 2

*Please show your work.*
*Partial credit will be given if you set up a problem correctly.*
*No credit will be given for correct answers with no supporting work.*

1. Finding no conventional parking spaces on campus, a student attempts to park his car over an unoccupied gap between the two structures of the Millbrook parking garage. He hits the accelerator as the car shoots across the gap to ensure that the car remains horizontal, then stops before the rear wheel rolls off of the left structure. The dimensions of his car are shown.

![Car diagram](image)

(a) What coefficient of friction is needed between the rear wheel and the garage to keep the car horizontal as the front wheel crosses the gap?

(b) What horizontal acceleration is required?

2. Washington University tows away the student's car, but fails to secure the car to the tow truck. The car's tires, which have an outer radius of 20 cm, do not slip relative to the truck. In the instant shown, the car is rolling backwards relative to the truck, and appears to be stationary relative to an observer standing on the road. The truck is moving to the right at 10 m/s and accelerating to the right at 0.1 m/s².

(a) What is the angular velocity of the car's wheels?

(b) If the car's wheels have a counterclockwise angular acceleration of 0.1 rad/s², what is the acceleration of the car's center of mass relative to a stationary observer?
3. One column of a poorly designed bridge blows up as the tow truck passes over it, leaving the roadway supported by only the hinge atop the left column. In terms of the mass $M$ and length $L$ of the bridge, what is the acceleration of the bridge's center of gravity just after the right column breaks?

4. Each of the solid cylindrical drums pictured below has a mass $M=100\text{kg}$ and a radius $R = 0.1\text{m}$. The ropes wrapped around the drums do not slip, and have negligible mass. Each system starts from rest in the configuration shown. For each of the three cases, find the velocity of the point A after point A drops 1 meter.