1. The impetus to merge Civil and Mechanical Engineering and the holes all over campus are part of the university's efforts to develop leadership in the field of underground, upside-down parking, in which a work study student pushes vehicles to the surface by imparting upon them a speed \( v \) in the configuration shown. What speed \( v \) is needed for the car to reach vertical in each of the following three situations?

(a) Arm: massless cable;
   Car: Uranium-filled Mini of mass \( m \) (treat as a point mass)

(b) Arm: heavy, rigid rod of mass \( M \),
   Car: Mini of negligible mass.

(c) Arm: Light, rigid rod of mass \( m \);
   Car: Uranium-filled Mini of mass \( m \) (treat as a point mass).
2. Controls lab merges with soils lab and transportation lab, preparing graduates for new lines of work. On the first day at the construction site, the graduate moves a crane so that $\frac{d\theta}{dt}$ is a 0.5 rad/s, $\frac{d^2\theta}{dt^2}$ is a 0.75 rad/s$^2$, $\omega$ is 0.75 rad/s, and $\frac{d\omega}{dt}$ is 2 rad/s$^2$. $l=10$m, $r=2$m, and $\theta=60^\circ$.

(a) What is the angular velocity of the boom AB?
(b) What is the angular acceleration of AB?
(c) What is the velocity of point B?
(d) What is the acceleration of point B?
3. The merging of fluids lab and construction management is particularly effective for workplace preparation. When placed against a wall at an angle $\theta=60^\circ$, the mop of length $l=1.5$m begins to slide such that end $A$ falls straight downwards along the wall at a constant speed of $1$ m/s, and end $B$ slides horizontally along the floor. What is the angular acceleration of the mop handle?
4. After taking the new combined sustainable design, asphalt, and vehicle dynamics lab, an engineer designs a replacement to the wheel designed to make the expansion of the Highway 40 less harmful to the environment. What following torque must be applied at the base of the axel for the wheel to spin with constant angular speed \( \omega \)?