A simple pendulum is placed on an elevator that accelerates upward as shown. If the pendulum is displaced an amount \( \theta_0 \) and released from rest relative to the elevator, find the tension \( T_0 \) in the supporting light rod when \( \theta = 0 \).

\[ \text{II. A small mass particle is given an initial velocity } v_0 \text{ tangent to the horizontal rim of a smooth hemispherical bowl at a radius } r_0 \text{ from the vertical centerline, as shown at point } A. \text{ As the particle slides past point } B, \text{ a distance } h \text{ below } A \text{ and a distance } r \text{ from the vertical centerline, its velocity } v \text{ makes an angle } \theta \text{ with the horizontal tangent to the bowl through } B. \text{ Determine } \theta. \]
III. The wheel of radius $r$ is free to rotate about the bent axle $CO$ that turns about the vertical axis at the constant rate $p$ rad/s. If the wheel rolls without slipping on the horizontal circle of radius $R$, determine the expressions for the angular velocity $\omega$ and angular acceleration $\alpha$ of the wheel. The $x$-axis is always horizontal.

$(25\%)$

IV. A car door is inadvertently left slightly open when the brakes are applied to give the car a constant rearward acceleration $a$. Derive expressions for the angular velocity of the door as it swings past the $90^\circ$ position and the components of the hinge reactions for any value of $\theta$. The mass of the door is $m$, its mass center is a distance $\bar{r}$ from the hinge axis $O$, and the radius of gyration about $O$ is $k_O$.

$(25\%)$