Exercises in Physics
Assignment # 9

Date Given: June 9, 2022
Date Due: June 16, 2022

P1. (1 point) The car passes over the top of a vertical curve at A with a speed of 60km/h and then passes through the bottom of a dip at B. The radii of curvature of the road at A and B are both 100m. Find the speed of the car at B if the normal force between the road and the tires at B is twice that at A. The height of the mass center of the car is 1m from the road.

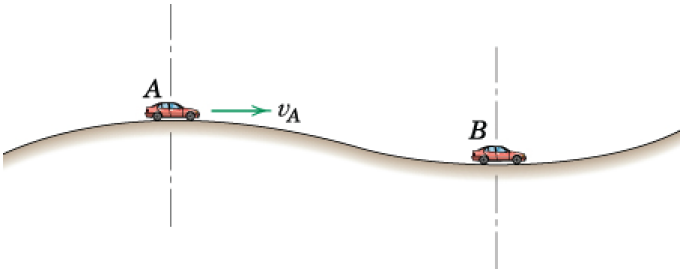

Figure 1: Illustration to Problem 1.

P2. (2 points) The robot arm is elevating and extending simultaneously. At a given instant, $\theta = 30^\circ$, $\dot{\theta} = \pi/3\,\text{rad/s}$, and $\ddot{\theta} = 2\pi/3\,\text{rad/s}^2$ $l = 0.5\,\text{m}$, $\dot{l} = 0.5\,\text{m/s}$, and $\ddot{l} = -0.5\,\text{m/s}^2$. Compute the radial and transverse forces F_r and F_θ that the arm must exert on the gripped part P, which has a mass of 1.2 kg. Compare with the case of static equilibrium in the same position.

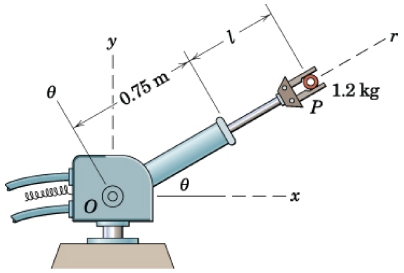

Figure 2: Illustration to Problem 2.

P3. (3 points) The slotted arm revolves in the horizontal plane[1] about the fixed vertical axis through point O. The 1kg slider C is drawn toward O at the constant rate of 10mm/s by pulling the cord S. At the instant for which $r = 200$mm, the arm has a counterclockwise angular velocity $\omega = 3$rad/s and is speeding up at the rate of 1rad/s^2. For this instant, determine the tension T in the cord and the magnitude N of the force exerted on the slider by the sides of the smooth[2] radial slot. Indicate which side, A or B, of the slot contacts the slider.

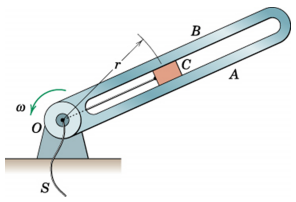

Figure 3: Illustration to Problem 3.

P4. (2 points) Beginning from rest when $\theta = 20^o$, a 35kg child slides with negligible friction down the sliding board which is in the shape of a 2.5m circular arc. Determine the tangential acceleration and speed of the child, and the normal force exerted on her (a) when $\theta = 30^o$ and (b) when $\theta = 90^o$.

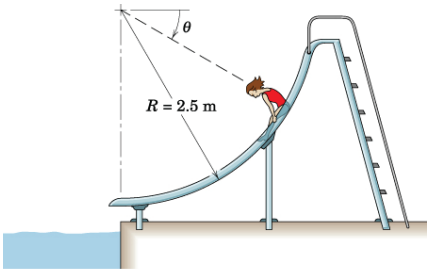

Figure 4: Illustration to Problem 4.

[1] So, gravity can be ignored.
[2] So, friction can be ignored.