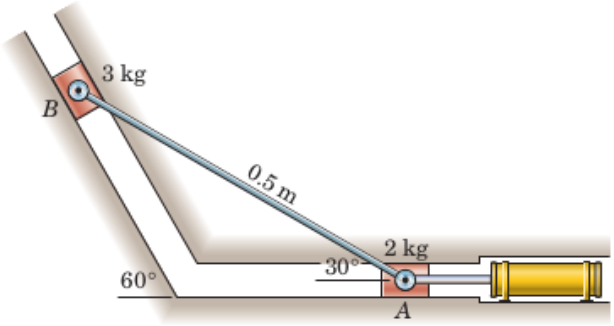
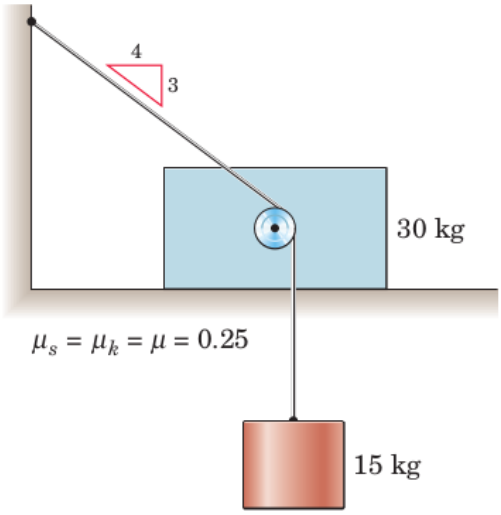
DYNAMICS (ME232)

Tutorial-3: Kinetics of particles

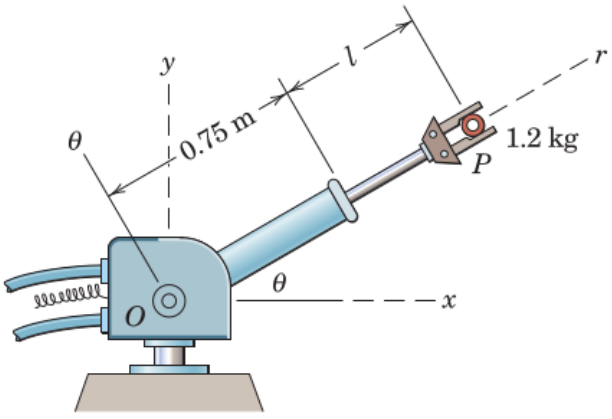
1. The slider A and B are connected by a light rigid bar and move with negligible friction in the slots, both of which lie in a horizontal plane. For the position shown, the hydraulic cylinder imparts a velocity and acceleration to slider A of $0.4m/s$ and $2m/s^2$, respectively, both to the right. Determine the acceleration of slider B and the force in the bar at this instant.



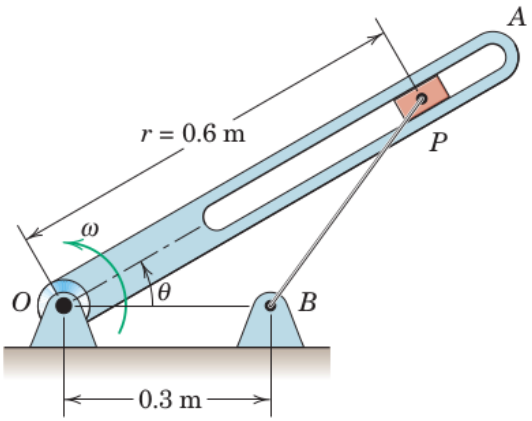
2. The system is released from rest in the position shown. Calculate the tenstion T in the cord and the acceleration a of the 30-kg block. The small pulley attached to the block has negligible mass and friction.



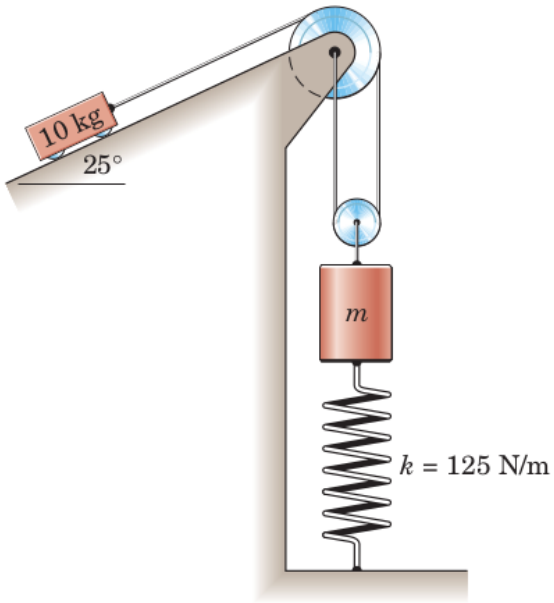
3. The robot arm is elevating and extending simultaneously. At a given instant, $\theta = 30°$, $\dot{\theta} = 40deg/s$ and $\ddot{\theta} = 120deg/s^2$, $l = 0.5m$, $\dot{l} = 0.4m/s$ and $\ddot{l} = -0.3m/s^2$. Compute the radial and transverse forces F_r and F_θ that the arm must exert on the gripped part P, which has a mass of 1.2 kg. Compare with the case of static equillibrium in the same position.



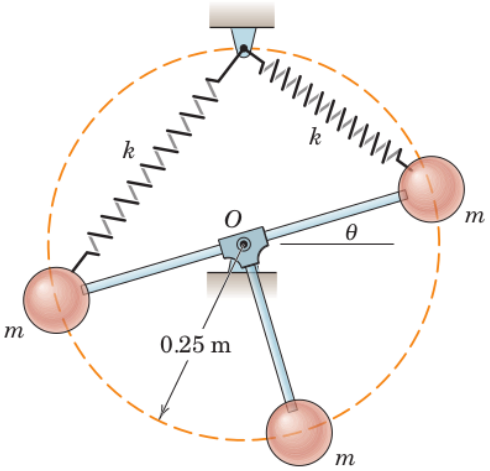
4. The slotted arm OA rotates about a horizontal axis through point O. The $0.2-kg$ slider P moves with negligible friction in the slot and is controlled by the inextensible cable BP. For the instant under consideration, $\theta = 30°, \omega = \dot{\theta} = 4rad/s, \ddot{\theta} = 0$, and $r = 0.6m$. Determine the corresponding values of the tension in cable BP and the force reaction R perpendicular to the slot. Which side of the slot contacts the slider?



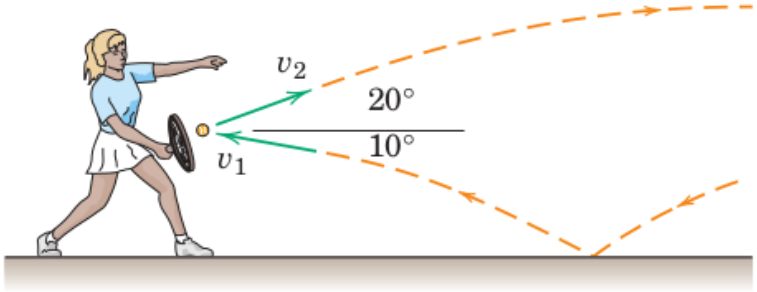
5. The system is released from rest with no slack in the cable and with the spring stretched $200mm$. Determine the distance s straveled by the $10-kg$ cart before it comes to rest (a) if m approaches zero and (b) if $m = 2kg$. Assume no mechanical interference.



6. The two springs, each of stiffness $k = 1.2kN/m$ are of equal length and undeformed when $\theta = 0$. If the mechanism is released from rest in position $\theta = 20°$, determine the angular velocity $\dot{\theta}$ when $\theta = 0$. The mass m of each sphere is $3kg$. Treat the sphere as particles and neglect the masses of the light rods and springs.



7. A tennis player strikes the tennis ball with her racket while the ball is still rising. The ball speed before impact with the racket is $v_1 = 15m/s$ and after impact its speed is $v_2 = 22m/s$, with directions as shown in the figure. If the 60-g ball is in contact with the racket for 0.05 seconds, determine the magnitude of the average force $\mathbf{R}$ exerted by the racket on the ball. Find the angle β made by $\mathbf{R}$ with the horizontal. Comment on the treatment of the ball weight during impact.



8. A particle is launched with a horizontal velocity $v_0 = 0.55m/s$ from the 30° position shown and then slides without friction along the funnel-like surface. Determine the angle θ which its velocity vector makes with the horizontal as the particle passes level $O - O$. The value of r is 0.9 m.