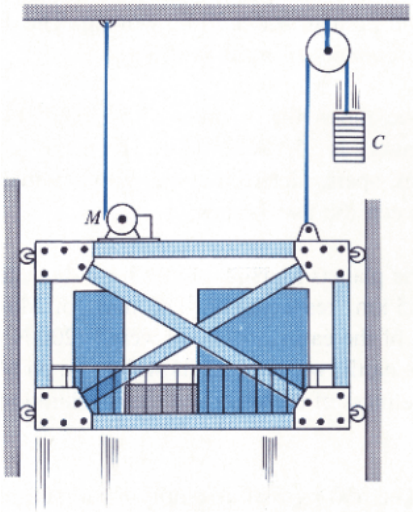
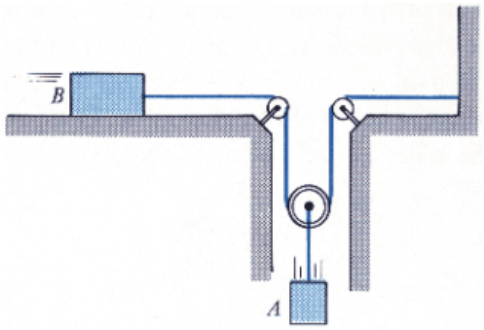
Engineering Dynamics
Homework 2

1.
A freight elevator, including its load, has a mass of 200 kg. It is prevented from rotating by using the track and wheels mounted along its sides. If the motor *M* develops a constant tension *T*=1.4 kN in its attached cable, determine the velocity of the elevator when it has moved upward 10 m starting from rest. Neglect the mass of the pulleys and cables. The counterweight *C* has a mass of 150 kg.



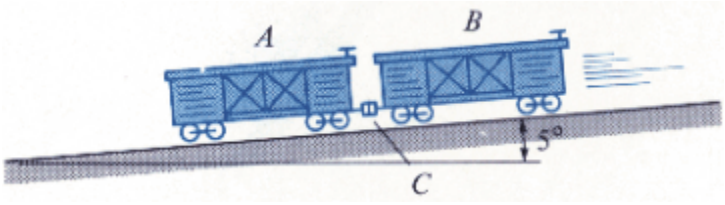
v= _____m/s

2.
At a given instant the 14-lb block A is moving downward with a speed of 7 ft/s. Determine its speed 3 s later. Block B has a weight of 4 lb, and the coefficient of kinetic friction between it and the horizontal plane is μ_k=0.2. Neglect the mass of the pulleys and cord.



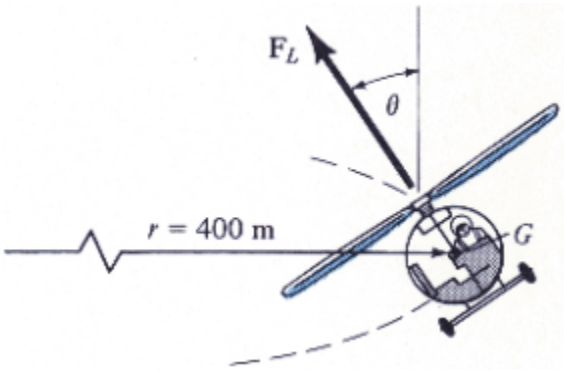
v_A= _____ft/s

3.
The two boxcars A and B have a weight of 10,500 lb and 25,500 lb, respectively. If they are freely coasting down the incline when the brakes are applied to all the wheels of car A determine the force in the coupling C between the two cars. The coefficient of friction between the wheels of A and the tracks is μ=0.45. The wheels of car B are free to roll. Neglect their mass in the calculation. Suggestion: Solve the problem by representing single resultant normal forces acting on A and B, respectively.



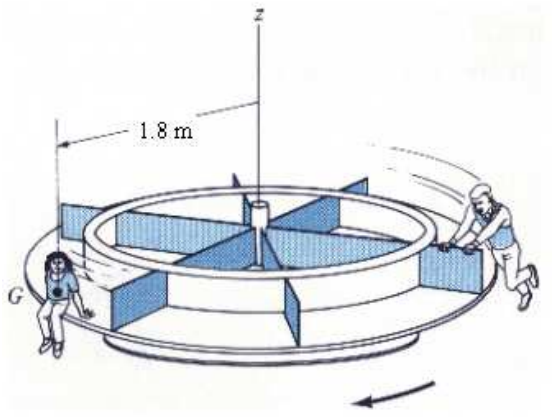
F_C= _____lb

4.
The 5.5-Mg helicopter maneuvers a horizontal turn having a radius of curvature r=400 m. Determine the lift force F_L required and the angle of bank θ when it is flying with a constant speed of v=35 m/s. Show that θ increases if v increases by also calculating θ when v=75 m/s.



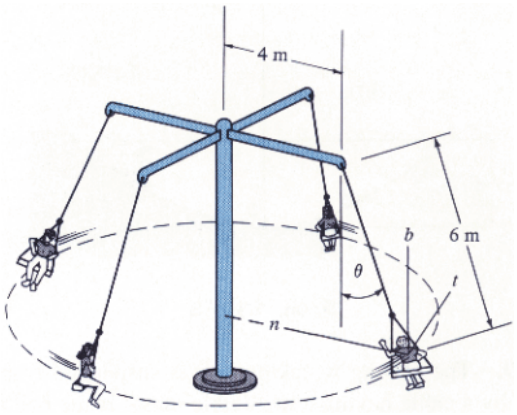
$|F_D|$= _____ kN
θ_{40}= _____ °
θ_{60}= _____ °

5.
A girl having a mass of 28 kg sits at the edge of the merry-go-round so her center of mass G is at a distance of 1.8 m from the axis of rotation. If the angular motion of the platform is slowly increased so that the girl's tangential component of acceleration can be neglected, determine the maximum speed which she can have before she begins to slip off the merry-go-round. The coefficient of friction between the girl and the merry-go-round is μ=0.31.



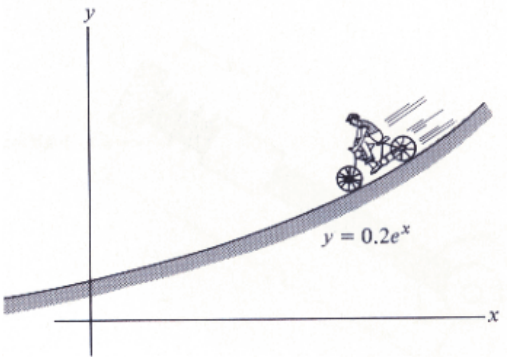
v_{max}= _____m/s

6.
Determine the constant speed of the chairs on the amusement park ride if it is observed that the supporting cables are directed at θ=35º. from the vertical. Each chair including its passenger has a mass of 75 kg. Also, what are the components of force in the n, t, and b directions which a 50-kg passenger exerts on the chair during the motion?



v= _____ m/s
F_n= _____ N
F_t= _____ N
F_b= _____ N

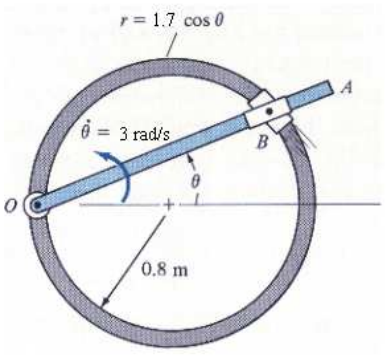
7.
The cyclist is freely coasting down the hill defined by the shape y=0.2e^x. If he has a speed of 13 m/s when y=0.3 m, determine the resultant normal reaction he exerts on the ground and the rate of increase in his speed at this instant. He and his bicycle have a total mass of 75-kg. Neglect friction, the mass of the wheels, and the size of the bicycle.



N= _____ kN
$\dot{v}$ = _____ m/s^2

8.

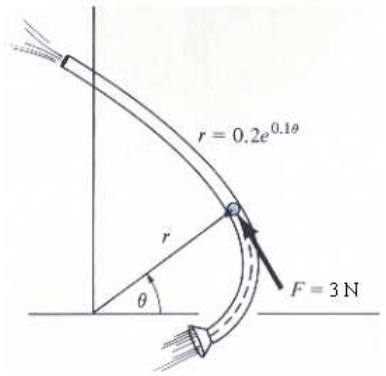
Rod OA rotates counterclockwise with a constant angular rate $\dot{\theta}$=3 rad/s. The double collar B is pin-connected together such that one collar slides over the rotating rod and the other collar slides over the horizontal circular rod described by the equation r=(1.7 cos θ) m. If both collars have a mass of 0.6 kg, determine the magnitude of the force which the circular rod exerts on one of the collars (N_k) and the magnitude of the force that OA exerts on the other collar (N_r) at the instant θ=45º.



N_k= _____ N
N_r= _____ N

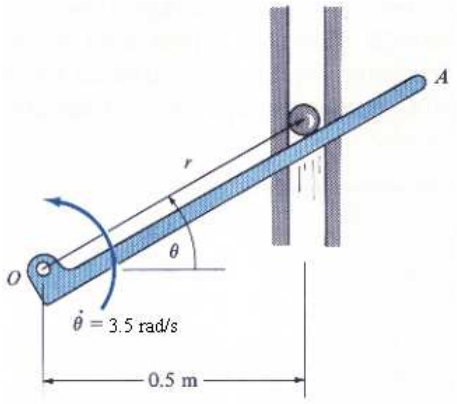
9.

Using air pressure, the 0.7 kg ball is forced to move through the tube lying in the horizontal plane and having the shape of a logarithmic spiral. If the tangential force exerted on the ball due to the air is 3 N, determine the magnitude and direction of the rate of increase in the ball's speed at the instant θ=π/3. Use the angle ψ to calculate your answer.



a_t= _____ m/s^2
ψ= _____ º

10.
The particle has a mass of 0.4 kg and is confined to move along the smooth vertical slot due to the rotation of the arm *OA*. Determine the force of the rod on the particle (N_r) and the normal force of the slot on the particle (N_s) when $\dot{\theta}$=35º. The rod is rotating with a constant angular velocity of =35 rad/s. Assume the particle contacts only one side of the slot at any instant.



N_s= _____ N
N_r= _____ N