Concordia UNIVERSITY

Faculty of Engineering and Computer Science

FINAL EXAMINATION ENGR 243/4 Dynamics **Sec:** T,V,X,XX **Date:** April 25, 2002

Instructors: Professors Dargahi, Gauthier, Povitski, Stathopoulos (coordinator)

Materials allowed: Non-programmable calculators **Time allowed**: 3 hours

Special instructions: Problems carry equal weight. Solve any FIVE of the given 6 problems.

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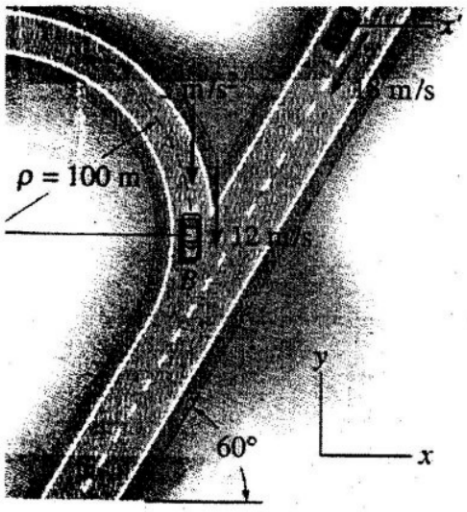
1. At the instant shown cars A and B are traveling with speeds of 18 m/s and 12 m/s, respectively. Also, at this instant, A has a decrease in speed of 2 m/s^2 and B has an increase in speed of 3 m/s^2. Determine the relative velocity and acceleration of B with respect to A.



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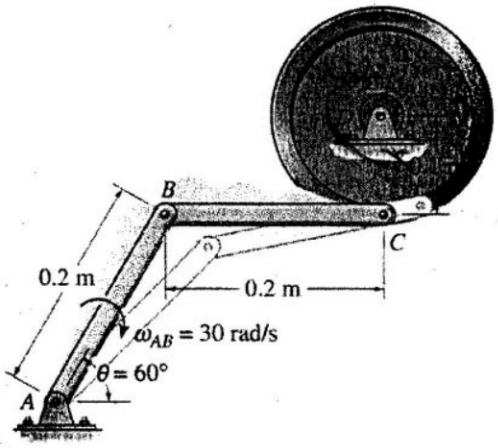
2. The bar AB of the linkage shown has a clockwise angular velocity of 30 rad/s when θ = 60°. Determine the angular velocities of member BC and of the wheel at this instant.

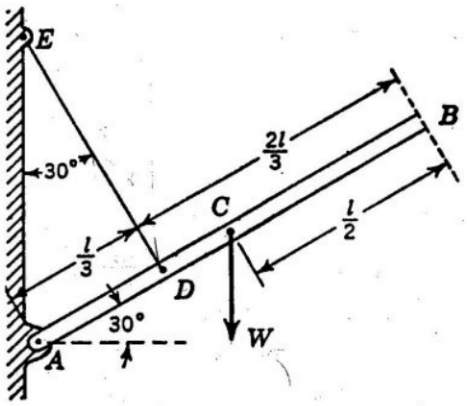


3. A slender prismatic bar AB is supported in a vertical plane, as shown. Calculate the magnitude of the total reaction R_A at the hinge A for the following cases:

   a) an instant before the string DE is cut;

   b) an instant after it is cut.

   Comment on the difference between the two values.



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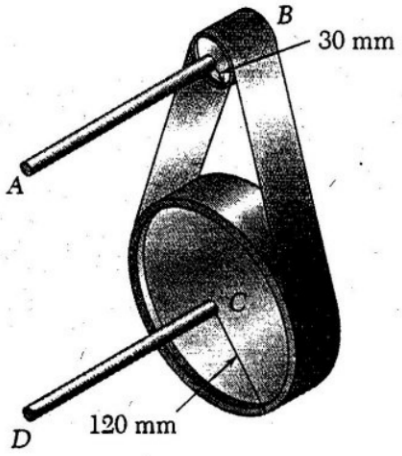
4. The shaft-disk-belt arrangement is used to transmit mechanical power from shaft AB to shaft CD. The inextensible belt moves with no sliding with respect to the disks. The shaft AB with its disk have a mass of 10 kg and a radius of gyration equal to 10 mm; the shaft CD with its disk have a mass of 1 kg and a radius of gyration equal to 5 mm.

a) Determine the angular speed of shaft CD if a couple M = 25 N.m applies to shaft AB and the power transmitted from shaft AB to shaft CD is equal to 2.5 kW.

b) Assuming the system starting from rest with the application of the above-mentioned couple, determine the number of revolutions of shaft AB before its angular velocity reaches 10 rad/s. Find the constant tangential force the belt exerts on shaft CD and its disk.



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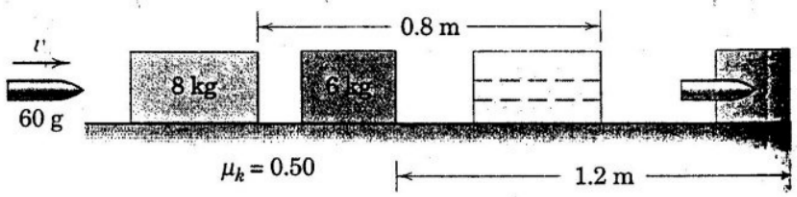
5. The 60-g bullet is fired at the two blocks resting on a surface where the coefficient of kinetic friction is 0.50. The bullet passes through the 8-kg block and lodges in the 6-kg block. The blocks slide the distances shown. Compute the initial velocity v of the bullet.



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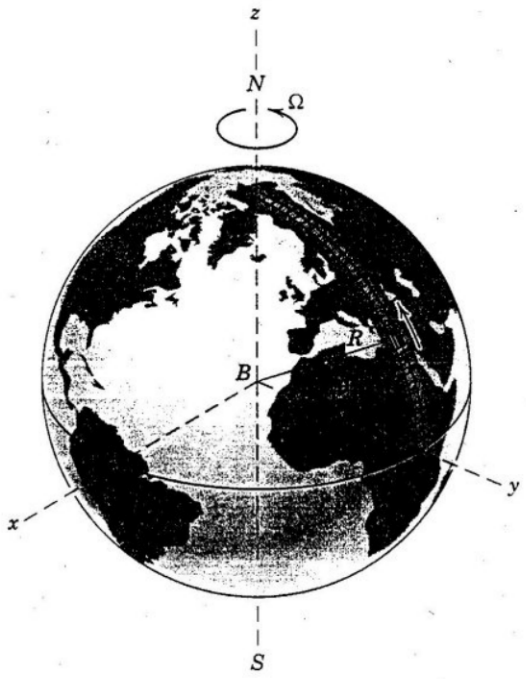
6. An experimental vehicle A travels with constant speed v relative to the earth along a north-south track, as shown. Determine the Coriolis acceleration a_{cor} as a function of the latitude θ. Assume an earth-fixed rotating frame Bxyz and a spherical earth. If the vehicle speed is v = 500 km/h, determine the magnitude of the Coriolis acceleration at

   a) the equator; and

   b) the north pole



Concordia UNIVERSITY

Faculty of Engineering and Computer Science

FINAL EXAMINATION ENGR 243/1 Dynamics **Sec:** AA, AV **Date:** June 22, 2002

Instructors: Professors Dargahi (coordinator), Stathopoulos

Materials allowed: Non-programmable calculators **Time allowed:** 3 hours

Special instructions: Problems carry equal weight. Solve any FIVE of the given 6 problems.

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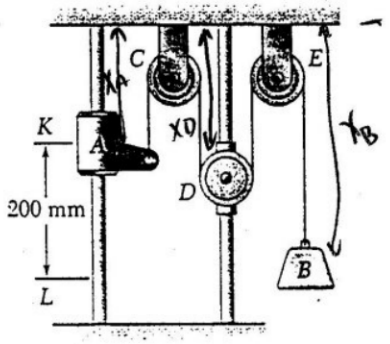
1. Collar A and block B are connected by a cable passing over three pulleys C, D, and E as shown. Pulleys C and E are fixed, while D is attached to a collar which is pulled downward with a constant velocity of 75 mm/s. At t = 0, collar A starts moving downward from position K with constant acceleration and no initial velocity. Knowing that the velocity of collar A is 300 mm/s as it passes through point L, determine the change in elevation, the velocity, and the acceleration of block B when collar A passes through L.



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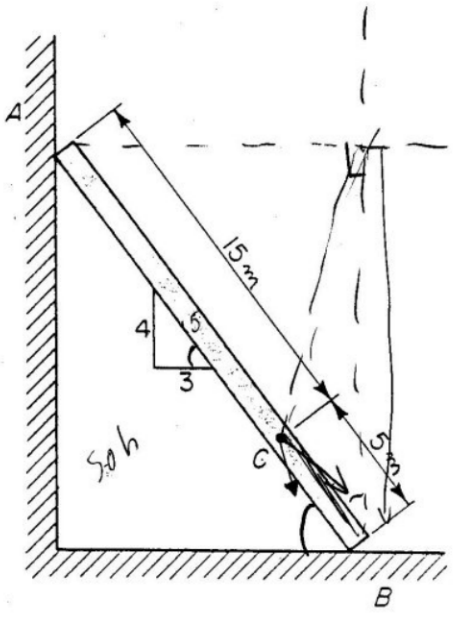
2. Bar AB moves with its ends in contact with the vertical and horizontal planes. In the position shown, the angular velocity of the bar is 2 rad/s counterclockwise, and its angular acceleration is 5 rad/s^2 counter-clockwise. Determine the acceleration of point C.



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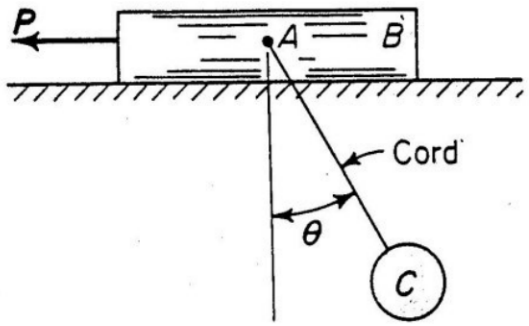
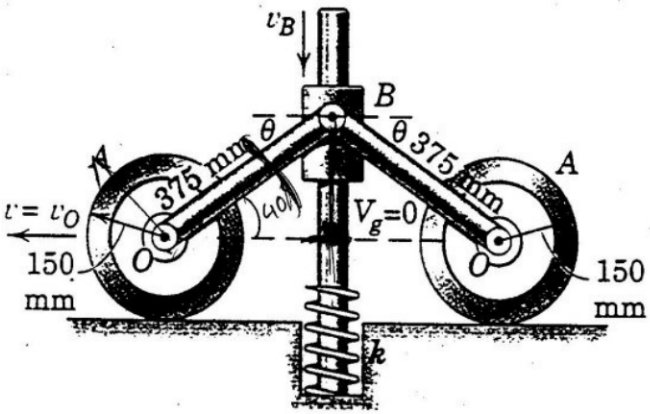
3. Body B weighs 322 lb and the homogeneous ball C, which is suspended from B at A by a cord, weighs 16.1 lb. The motion is such that the angle θ remains constant at 30° when the velocity of body B is to the left. Determine the value of force P. The coefficient of kinetic friction between body B and the plane is 0.10 and the gravity acceleration is 32.2 ft/s^2.

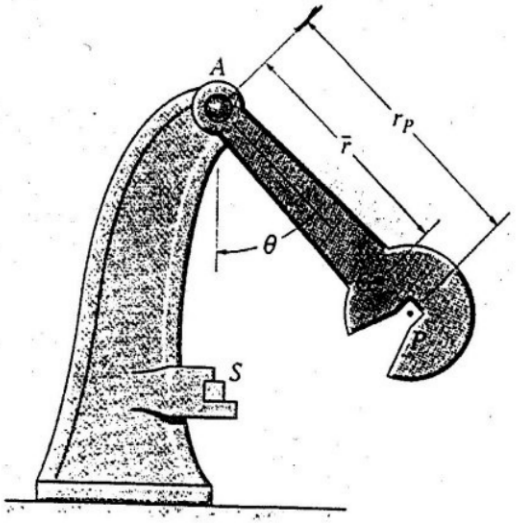


4. The mechanism shown, each of the two wheels has a mass of 30 kg and a centroidal radius of gyration of 100 mm. Each link OB has a mass of 10 kg and maybe treated as a slender bar. The 7 kg collar at B slides on the fixed vertical shafts with negligible friction. The spring has a stiffness of k = 30 KN/m and is contacted by the bottom of the collar when the links reached the horizontal position. If the collar is released from rest at the position θ = 45° and if friction is sufficient to prevent the wheels from sliping, determine:

a) The velocity V_B of the collar as it first strikes the spring.
b) The maximum deformation x of the spring.



5. The Charpy impact test is used in material impact testing to determine the energy absorption characteristics of a material during impact. The test is performed using the pendulum in Figure below, which has a mass m, mass center at G, and radius of gyration K_G about G. determine the distance r_p form the pin at A to the point p where the impact with the specimen S should occur so that the horizontal force at the pin is essentially zero during the impact. For the calculation, assuming the specimen all the pendulum kinetics energy gain during the time it falls and thereby stops the pendulum from swinging when $\theta = 0°$.



6. The drum shown has a mass of 60 Kg and a radius of gyration k_o = 0.25m. A cord of negligible mass is rapped around the periphery of the drum and attached to the block having a mass of 20 kg. If the block is released, determine the drum's angular acceleration.