INDIAN INSTITUTE OF TECHNOLOGY, BHUBANESWAR

ASSIGNMENT NO. -02

Course: ME 20001 (DYNAMICS) (Third Semester, 2011)

[Plane Motion of Rigid Bodies with Rotating & Fixed frame, Motion about a fixed point, General Motion of Rigid Bodies in three Dimension]

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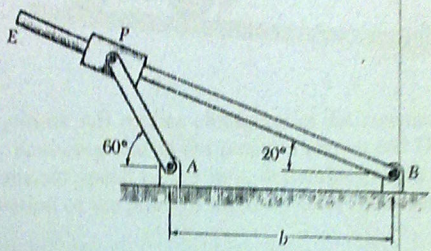
1. Two rotating rods are connected by slider block P. The rod attached at A rotates with a constant clockwise angular velocity ω_A. For the given data, determine for the position ~~for the position~~ shown (a) the angular velocity of the rod attached at B. (b) the relative velocity of slider block P with respect to the rod on which it slides.

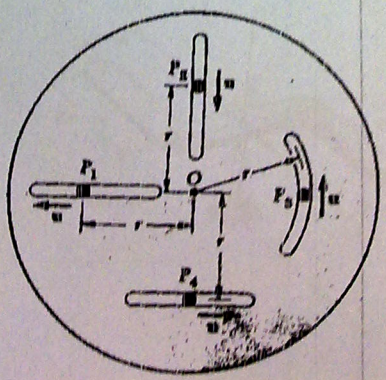
   $b = 200\text{mm}$, $\omega_A = 6$ rad/s



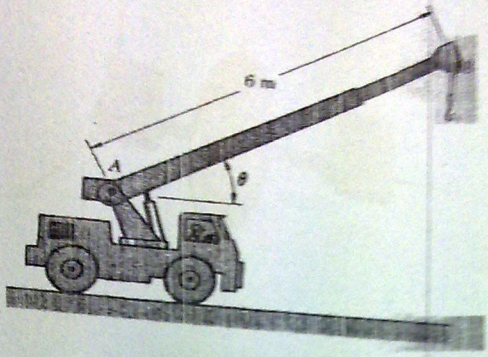
2. Two rotating rods as shown above are connected by slider block P. The velocity v_0 of the slider block relative to the rod on which it slides is constant and is directed outward. For the given data, determine the angular velocity of each rod for the position shown.

   $b = 200\text{mm}$, $v_0 = 225$ mm/s

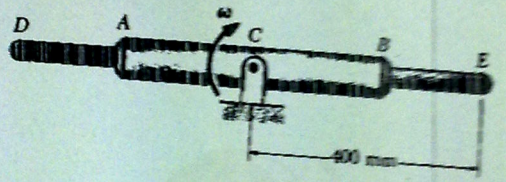
3. Four pins slide in four separate slots cut in a circular plate as shown. When the plate is at rest, each pin has a velocity directed as shown and of the same constant magnitude u. if each pin maintains the same velocity in relation to the plate when the plate rotates about O with a constant counter clockwise angular velocity ω, determine the acceleration of each pin.



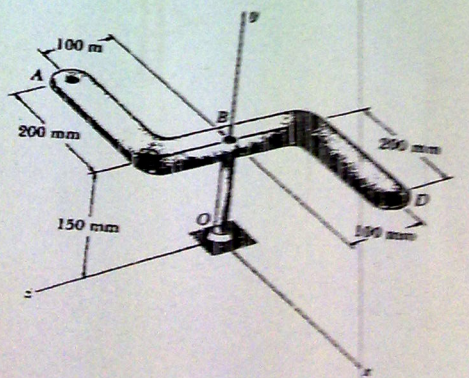
4. At the instant shown the length of the boom is being decreased at the constant rate of 150 mm/s and the boom is being lowered at the constant rate of 0.075 rad/s. Knowing that $\theta = 30^0$, determine (a) the velocity of point B, (b) the acceleration of point B.



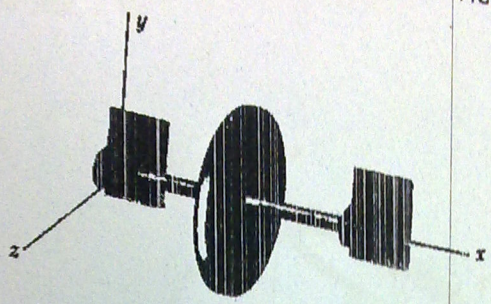
5. The hollow cylinder AB rotates clockwise at the constant rate $\omega = 8$ rad/s about and axis at C. Knowing that in the position shown rod DE is being moved to the right at the constant speed of 2.5 m/s, determine (a) the acceleration of point E, (b) the acceleration of the point of the rod which coincides with point C.



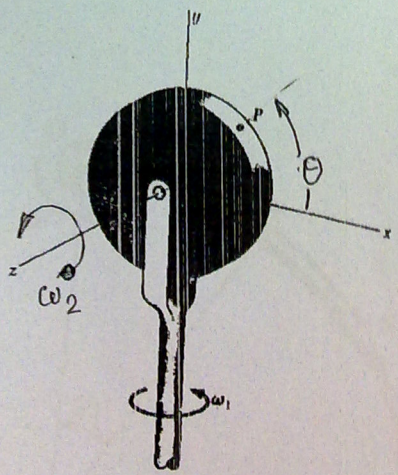
6. Plate ABD and rod OB are rigidly connected and rotate about the ball-and-socket joint O with an angular velocity $\omega = \omega_x\, i + \omega_y j + \omega_z\, k$. Knowing that Va = (75 mm/s) i + (350 mm/s) j + $(V_A)_z$ k and ω_x = 1.5 rad/s, determine (a) the angular velocity of the assembly, (b) the velocity of point D.



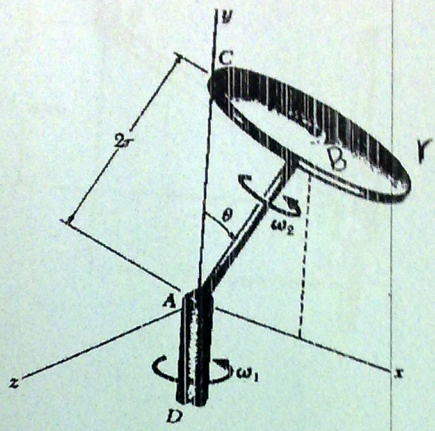
7. Knowing that the turbine rotor shown rotates at a constant rate ω =9000 r/min, determine the angular acceleration of the rotor, if the turbine housing has a constant angular velocity of 2.4 rad/s clockwise as viewed from (a) the positive y axis, (b) the positive z axis.



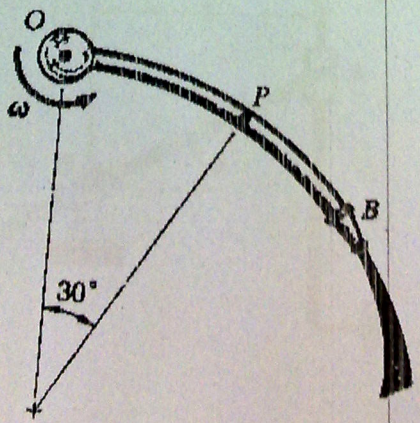
8. A disk of radius r spins at the constant rate ω_2 about a horizontal axle held by a fork-ended vertical rod which rotates at the constant rate ω_1. For the position shown, determine (a) the angular acceleration of the disk, (b) the acceleration of point P on the rim of the disk if $\theta = 0$, (c) the acceleration of P if $\theta = 90^0$.



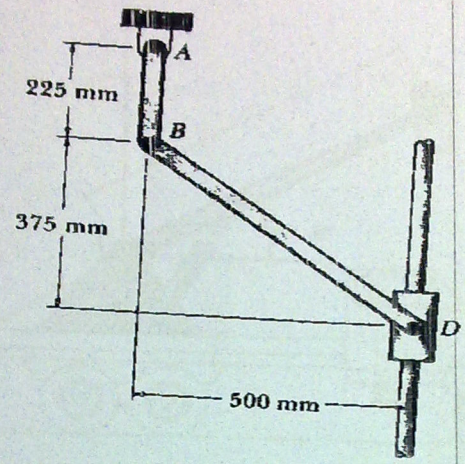
9. A disk of radius r is mounted on an axle of length 2r. The axle is attached to a vertical shaft AD which rotates at the constant rate ω_1 and the disk rotates about the axle AB at the constant rate ω_2. Knowing that the angle θ remains constant and that the rim of the disk touches the y axis, determine (a) the angular acceleration of the disk, (b) the velocity of point C of the disk, (c) the acceleration of point C of the disk.



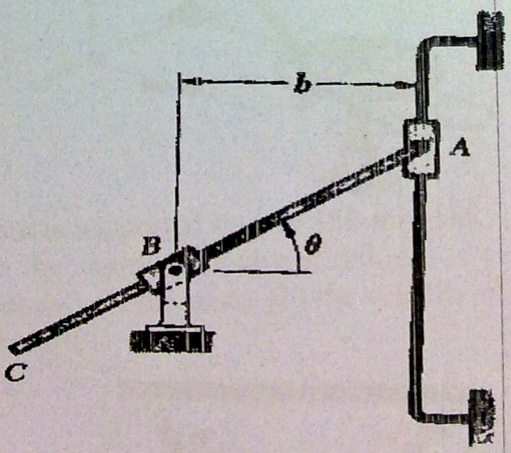
10. Water flows through the curve pipe OB., Which has a uniform radius of 450mm and which rotates with a constant counterclockwise angular velocity of 150 r/min. If the velocity of the water relative to the pipe in 13.5 m/s, determine the total acceleration of the particle of water P.



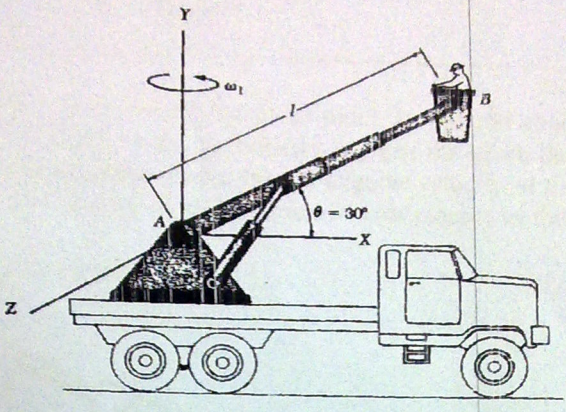
11. Knowing that at the instant shown, collar D moves downward with a constant velocity of 1500 mm/s, determine (a) the instantaneous center of rotation of link BD, (b) the angular velocities of crank AB and line BD, (c) the velocity of the mid point of link BD.



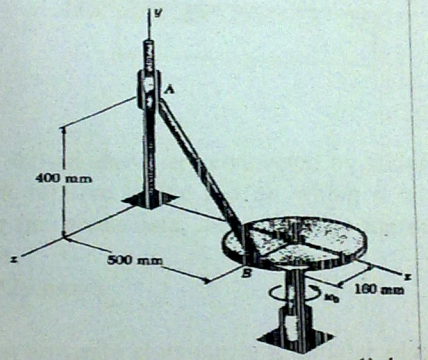
12. Rod AC of length 2b is attached to a collar at A and passed through a pivoted collar at B. Knowing that collar A moves upward with a constant velocity V_A, derive an expression for (a) the angular velocity of rod AC, (b) the velocity of the point of the rod in contact with the pivoted collar B, (c) the angular acceleration of rod AC.



13. The telescoping arm AB is used to raise a worker to the elevation of electric and telephone wires. Knowing that the length AB increases at the constant rate dl/dt = 0.20m/s and that arm rotates at the constant rate $\omega_1 = 0.25$ rad/s about a vertical axis, while the angle θ it forms with the horizontal maintains a constant value, determine the acceleration of point B when l = 5 m.



14. Rod AB is connected by ball-and-socket joints to collar A and to the 320-mm-diameter rotating disk C. Knowing that the disk rotates counter-clockwise in the z-x plane at the constant rate $\omega_0 = 4$ rad/s, determine the velocity of collar A.



15. A rectangular plate is supported by two 150-mm links as shown. Knowing that at the instant shown the angular velocity of link AB is 4 rad/s clockwise, determine (a) the angular velocity of the plate, (b) the velocity of the center of the plate, (c) the velocity of corner F.