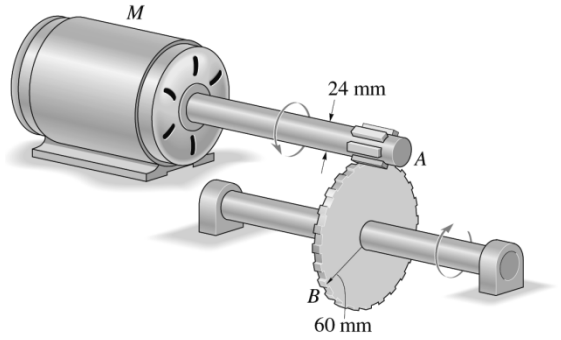
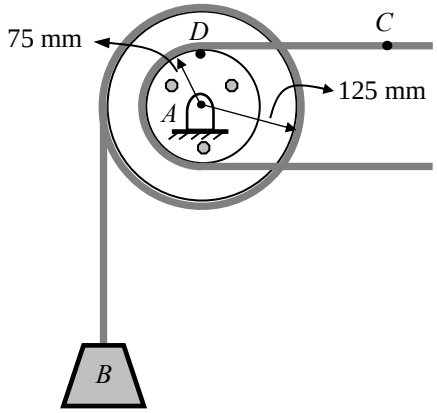
CE222 Spring 2014-2015
Home Exercise 4 (Rigid Body Kinematics)

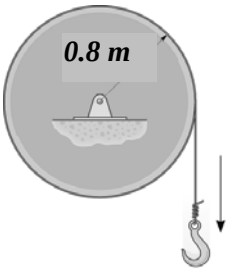
Q1. Due to an increase in power, the motor *M* rotates the shaft A with an angular acceleration of $\alpha = (0.06\theta^2)$ rad/s^2, where θ is in radians. If the shaft is initially turning at ω_0 = 50 rad/s, determine the angular velocity of gear B after the shaft undergoes an angular displacement $\Delta\theta$ = 10 rev.



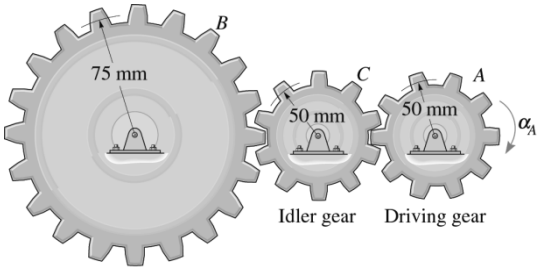
Q2. Load *B* is connected to a double pulley by one of the two inextensible cables shown. The motion of the pulley is controlled by cable *C*, which has a constant acceleration of 225 mm/s^2 and an initial velocity of 300 mm/s^2, both directed to the right. Determine
(a) the number of revolutions executed by the pulley in 2 s,
(b) the velocity and change in position of the load *B* after 2 s, and
(c) the acceleration of point *D* on the rim of the inner pulley at t = 0.



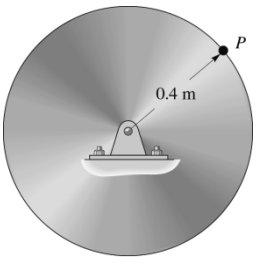
Q3. The hook moves from rest with an acceleration of 10 m/s^2. If it is attached to a cord which is wound around the drum, determine the angular acceleration of the drum and its angular velocity after the drum has completed 10 rev. How many more revolutions will the drum turn after it has first completed 10 rev and the hook continues to move downward for 4 s?



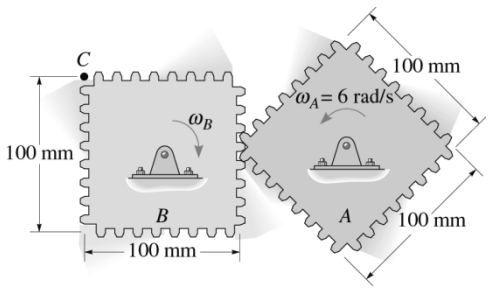
Q4. When only two gears are in mesh, the driving gear *A* and the driven gear *B* will always turn in opposite directions. In order to get them to turn in the same direction an idler gear *C* is used. In the case shown, determine the angular velocity of gear *B* when *t* = 5 s, if gear *A* starts from rest and has an angular acceleration of $\alpha_A = (3t+2)$ rad/s^2, where *t* is in seconds.



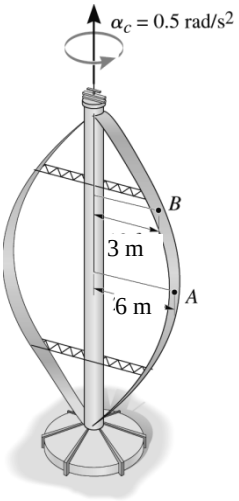
Q5. *(a)* A motor gives gear *A* an angular acceleration of $\alpha_A = (4t^3)$ rad/s^2, where *t* is in seconds. If this gear is initially turning at $(\omega_A)_0$ = 20 rad/s, determine the angular velocity of gear *B* when *t* = 2 s.
(b) The disk starts from rest and is given an angular acceleration $\alpha = (10\theta^{1/3})$ rad/s^2, where θ is in radians. Determine the angular velocity of the disk and its angular displacement when *t* = 4 s.



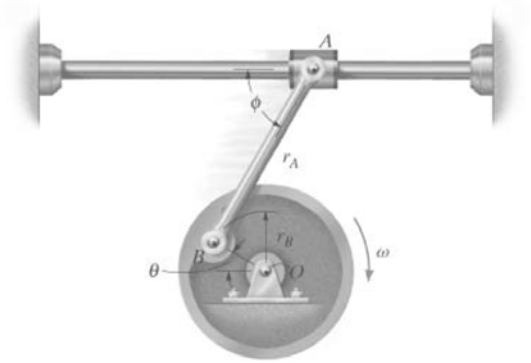
Q6. At the instant shown, gear *A* is rotating with a constant angular velocity of ω_A = 6 rad/s. Determine the largest angular velocity of gear *B* and the maximum speed of point *C*.



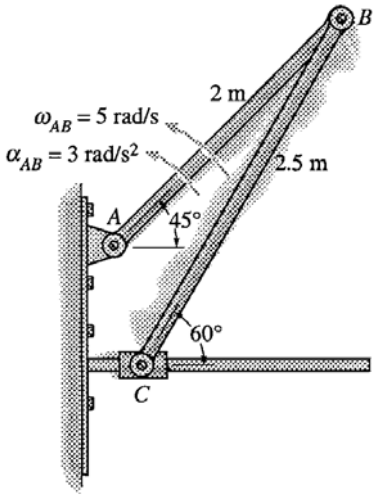
Q7. The vertical axis windmill consists of two blades that have a parabolic shape. If the blades are originally at rest and begin to turn with a constant angular acceleration of $\alpha = 0.5$ rad/s^2, determine the magnitude of the velocity and acceleration of points A and B on the blade after the blade has rotated through two revolutions.



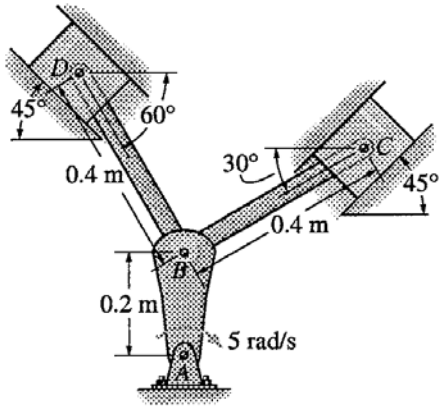
Q8. The wheel is rotating with an angular velocity $\omega = 8$ rad/s. Determine the velocity of the collar A at the instant $\theta = 30°$ and $\phi = 60°$. Also, sketch the location of bar AB when $\theta = 0°$, 30° and 60° to show its general plane motion. r_A=500 mm, r_B=150 mm,



Q9. Rod AB is rotating with an angular velocity $\omega_{AB} = 5$ rad/s. Determine the velocity of the collar C at the instant shown.

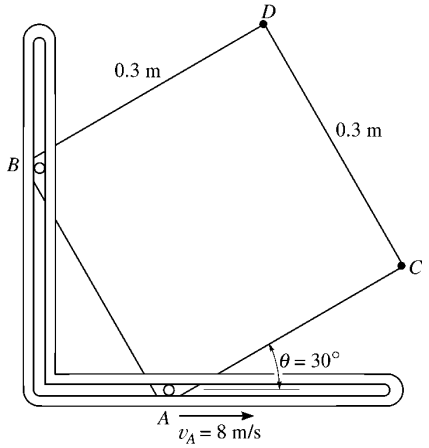


Q10. The mechanism used in a marine engine consists of a single crank AB and two connecting rods BC and BD. Determine the velocity of the piston at C the instant the crank is in the position shown and has an angular velocity of 5 rad/s.

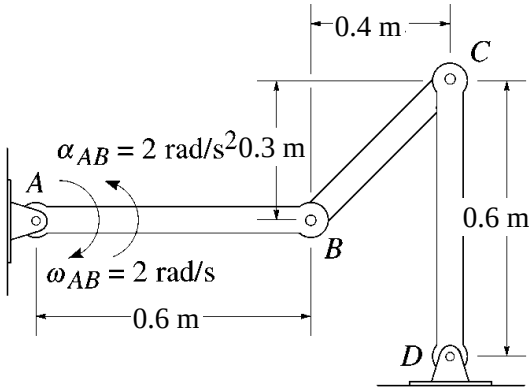


Q11. (*a*) The square plate is confined within the slots at A and B. When $\theta = 30°$, point A is moving at $v_A = 8$ m/s. Determine the velocity of point C at the instant.

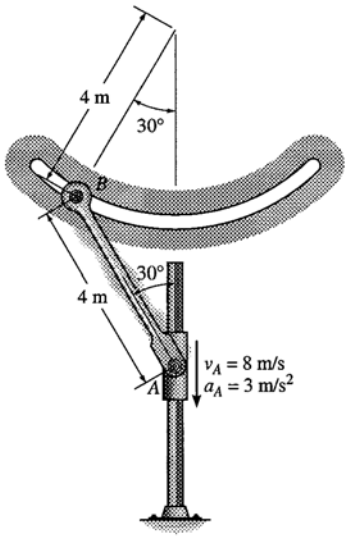
(*b*) The square plate is confined within the slots at A and B. When $\theta = 30°$, point A is moving at $v_A = 8$ m/s. Determine the velocity of point D at the instant.



Q12. At a certain instant, link *AB* has a clockwise angular velocity of ω_{AB} = 2 rad/s and counterclockwise angular deceleration of α_{AB} = 2 rad/s^2. Determine the acceleration of link *BC* at the instant shown.

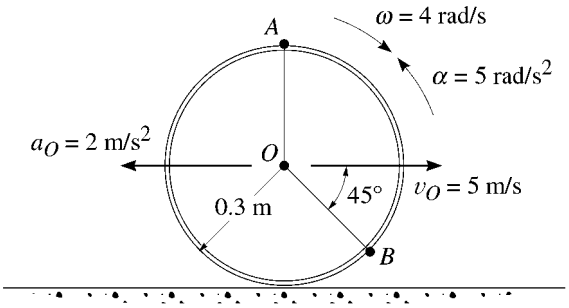


Q13. The ends of the bar AB are confined to move along the paths shown. At a given instant, *A* has a velocity of 8 m/s and an acceleration of 3 m/s^2. Determine the angular velocity and angular acceleration of AB at this instant.

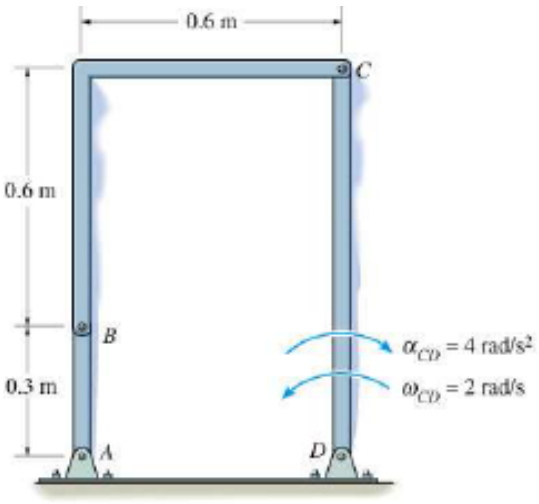


Q14. (*a*) The hoop is cast on the rough surface such that it has an angular velocity ω = 4 rad/s and an angular acceleration α = 5 rad/s^2. Also, its center has a velocity v_O = 5 m/s and a deceleration α_O = 2 m/s^2. Determine the acceleration of point *A* at this instant.

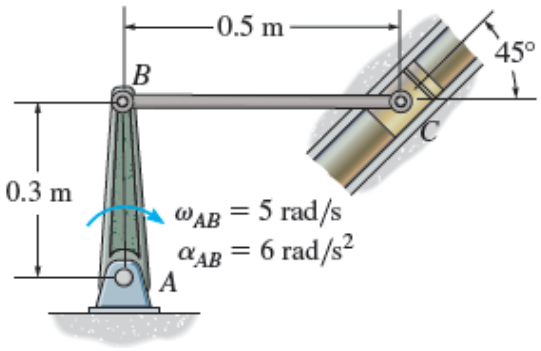
(*b*) The hoop is cast on the rough surface such that it has an angular velocity ω = 4 rad/s and an angular acceleration α = 5 rad/s^2. Also, its center has a velocity v_O = 5 m/s and a deceleration α_O = 2 m/s^2. Determine the acceleration of point *B* at this instant.



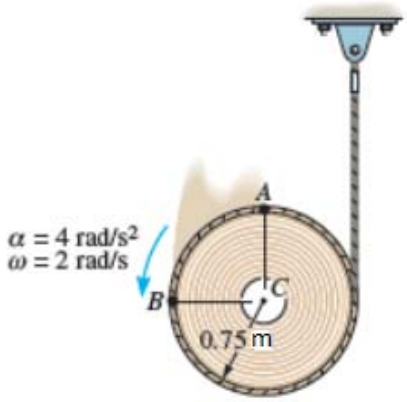
Q15. Determine the angular acceleration of link AB if link CD has the angular velocity and angular deceleration shown.



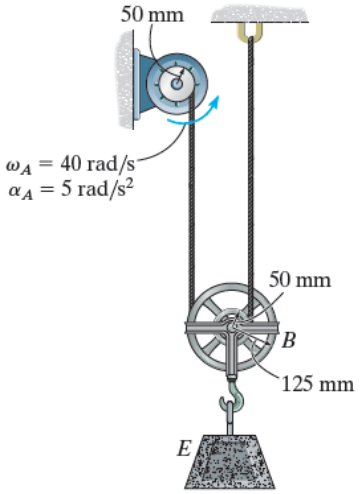
Q16. Crank *AB* is rotating with an angular velocity of w_{AB}=5 rad/s and an angular acceleration of α_{AB}=5 rad/s^2. Determine the angular acceleration of *BC* and the acceleration of the slider block *C* at the instant shown.



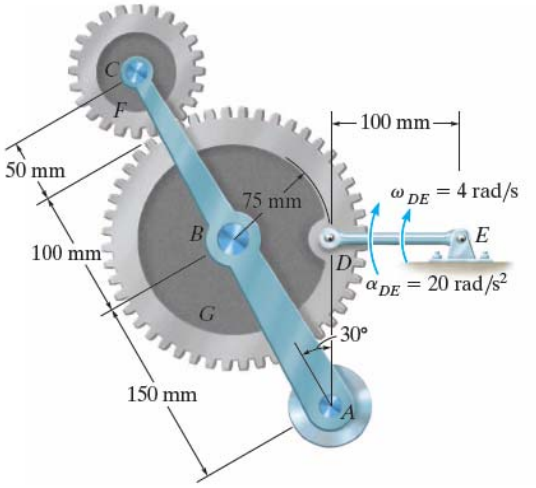
Q17. As the cord unravels from the cylinder, the cylinder has an angular acceleration of α=4 rad/s^2 and an angular velocity of w=2 rad/s at the instant shown. Determine the accelerations of points A and B at this instant.



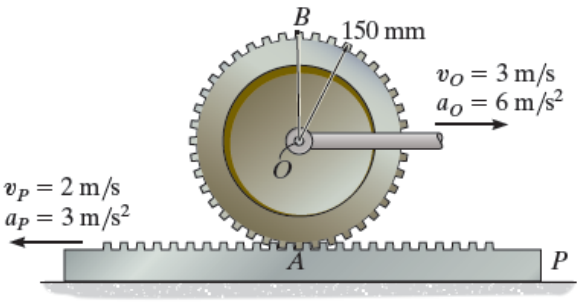
Q18. Pulley A rotates with the angular velocity and angular acceleration shown. Determine the acceleration of block E at the instant shown.



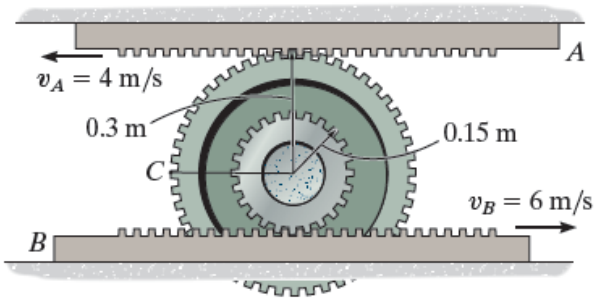
Q19. The tied crank and gear mechanism gives rocking motion to crank AC, necessary for the operation of a printing press. If link DE has the angular motion shown, determine the respective angular velocities of gear F and crank AC at this instant, and the angular acceleration of crank AC.



Q20. The center O of the gear and the gear rack P move with the velocities and accelerations shown. Determine the angular acceleration of the gear and the acceleration of point B located at the rim of the gear at the instant shown.



Q21. Determine the angular velocity of the double-tooth gear and the velocity of point C on the gear.



Q22. Crank AB rotates with the angular velocity and angular acceleration shown. Determine the acceleration of the slider block C at the instant shown.