HW # 2: Planar Kinematics

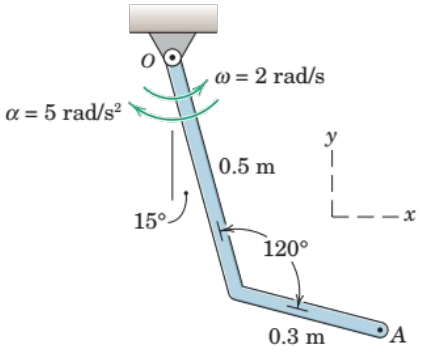

Figure 1

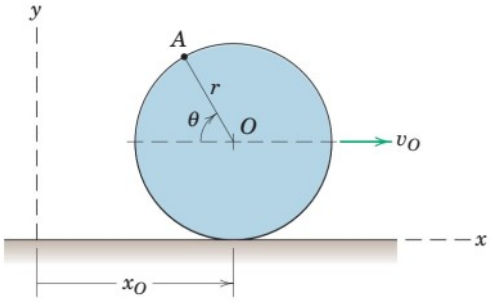

Figure 2

Q1: The bent flat bar rotates about a fixed axis through point O with the instantaneous angular properties indicated in the Figure 1. Determine the velocity and acceleration of point A.

Q2. The wheel of radius *r* rolls without slipping, and its center *O* has a constant velocity v_O to the right as shown in Figure 2. Determine expressions for the magnitudes of the velocity *v* and acceleration *a* of point *A* on the rim by differentiating its *x*- and *y*-coordinates.

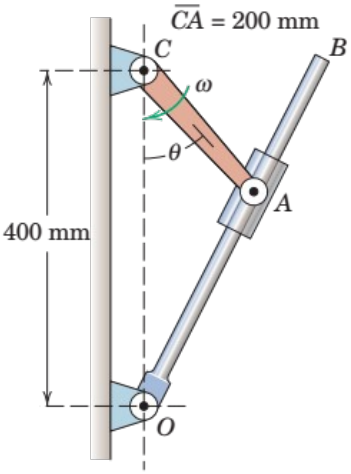

Figure 3

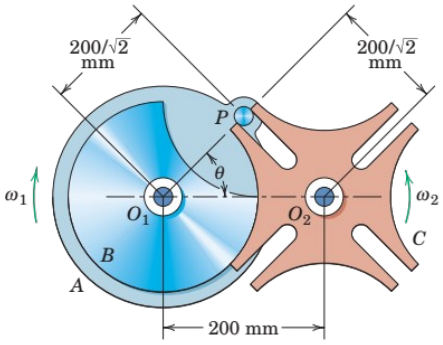

Figure 4

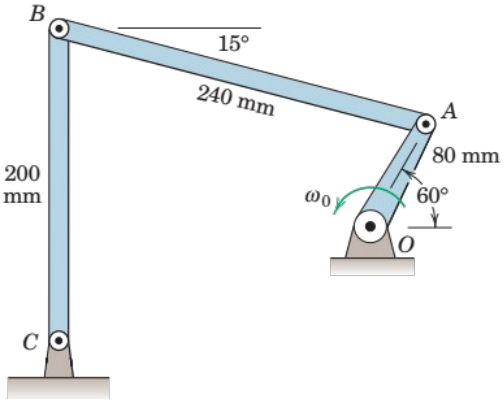

Figure 5

Q3. The rod *OB* slides through the collar pivoted to the rotating link at *A* as shown in Figure 3. If *CA* has an angular velocity ω = 3 rad/s for an interval of motion, calculate the angular velocity of *OB* when θ = 45°.

Q4. Figure 4 shows the Geneva wheel mechanism used for producing intermittent rotation. Pin *P* in the integral unit of wheel *A* and locking plate *B* engages the radial slots in wheel *C*, thus turning wheel *C* one-fourth of a revolution for each revolution of the pin. At the engagement position shown, θ = 45°. For a constant clockwise angular velocity ω_1 = 2 rad/s of wheel *A*, determine the corresponding counterclockwise angular velocity ω_2 of wheel *C* for θ = 20°. (Note that the motion during engagement is governed by the geometry of triangle O_1O_2P with changing θ.)

Q5. A four-bar linkage is shown in the Figure 5 (the ground "link" *OC* is considered the fourth bar). If the drive link *OA* has a counterclockwise angular velocity ω_0 = 10 rad/s, determine the angular velocities of links *AB* and *BC*.

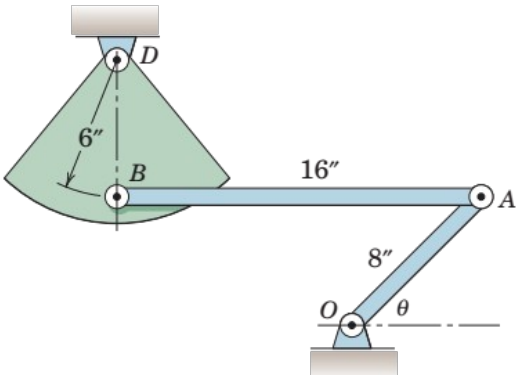

Figure 6

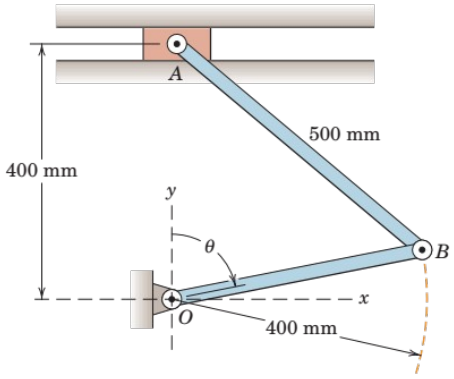

Figure 7

Q6. Link *OA* has a counterclockwise angular velocity $d\theta/dt$ = 4 rad/sec during an interval of its motion. Use method of instantaneous centre of rotation to determine the angular velocity of link AB and of sector BD for θ = 45° at which instant AB is horizontal and BD is vertical.

Q7. For the Figure 7, determine the angular acceleration of *AB* and the linear acceleration of *A* for the position θ = 90° if $d\theta/dt$ = 4 rad/s and $d^2\theta/dt^2$ = 0 at that position.

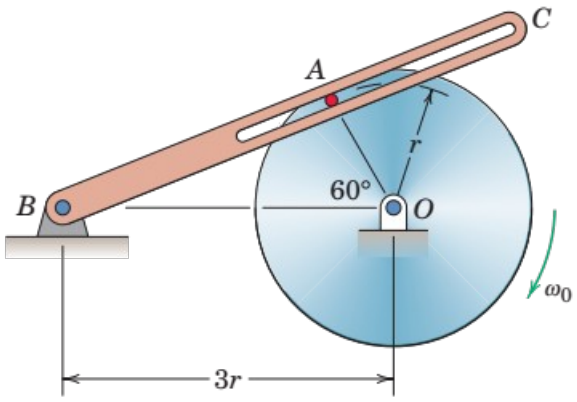

Figure 8

Q8. The disk rotates about a fixed axis through point *O* with a clockwise angular velocity ω_0 = 20 rad/s and a counterclockwise angular acceleration α_0 = 5 rad/s^2 at the instant under consideration (see Figure 8). The value of *r* is 200 mm. Pin *A* is fixed to the disk but slides freely within the slotted member *BC*. Determine the velocity and acceleration of *A* relative to slotted member *BC* and the angular velocity and angular acceleration of BC.