Position, Velocity, and Acceleration Analysis

1. The mechanism shown in Figure #1 is used to feed cartons to a labeling machine and, at the same time, to prevent the stored cartons from moving down. At full speed, the driveshaft rotates clockwise with an angular velocity of 200 rpm.

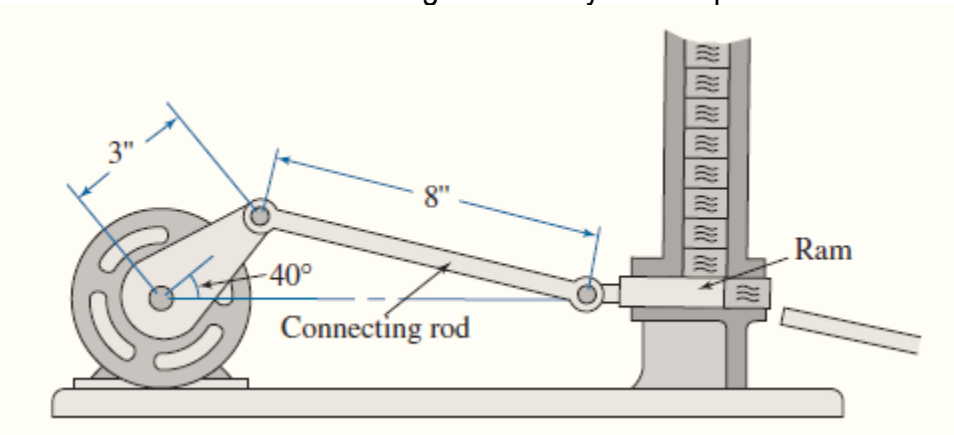
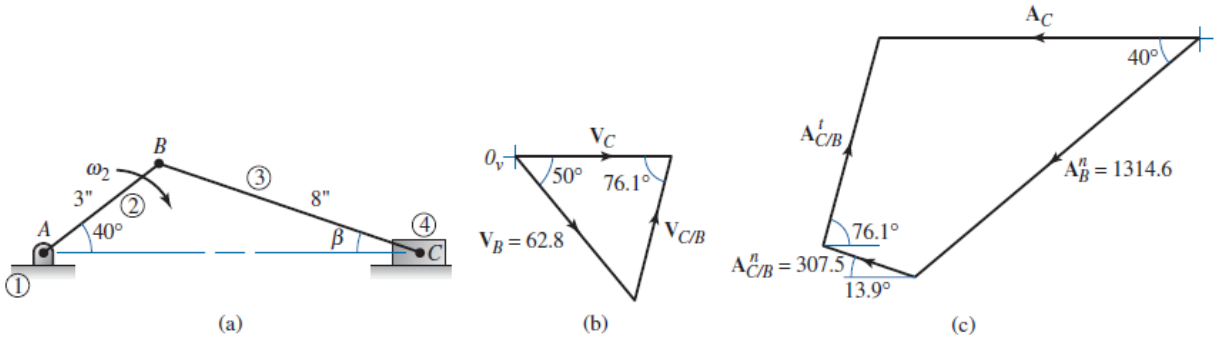


Figure #1 Mechanism for Problem #1.

a. At the instant shown, determine the acceleration of the ram and the angular acceleration of the connecting rod.

b. Verify that the Kinematic Diagram for the mechanism is as shown in Figure (a), (b), and (c):



2. Use MATLAB to conduct an acceleration analysis on the inverted slider-crank linkage shown in Figure #2 if the crank rotates at a constant 10 rad/s. Plot the *x* and *y* components of the acceleration at point *P*. Also, plot the acceleration of slip between the slider and rocker. ***Note:*** Use the MATLAB scripts discussed in class and modify them to solve slider-crank mechanism problem.

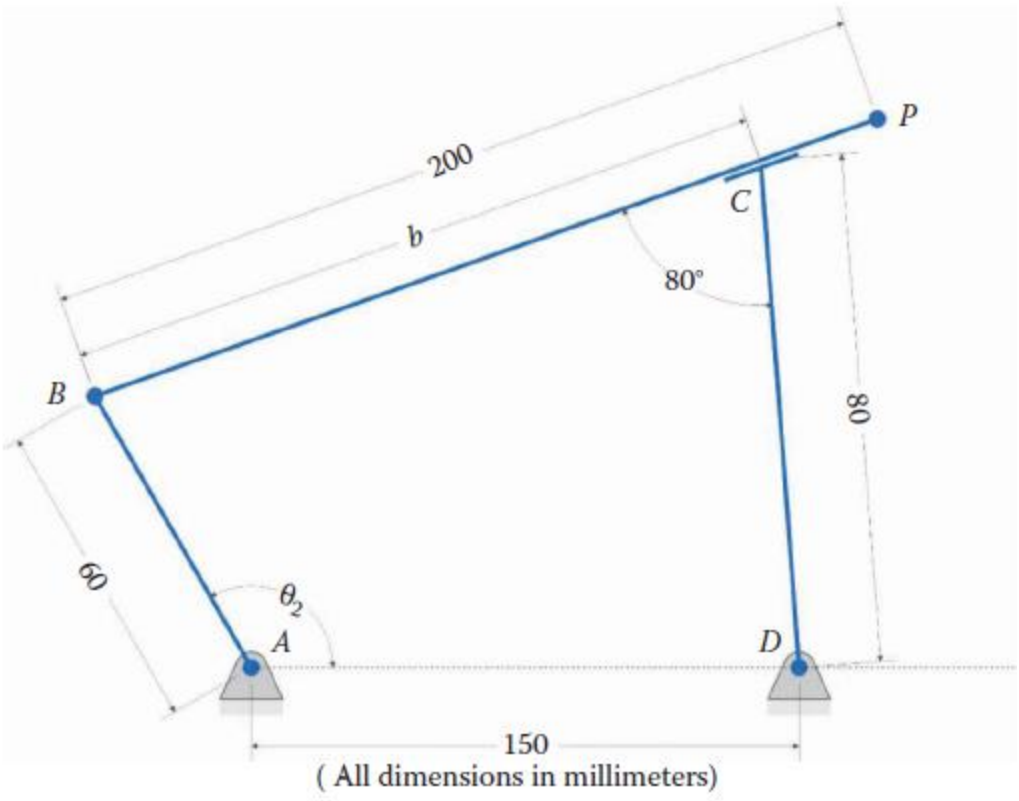


Figure #2 Slider-Crank Linkage for Problem #2.

Follower-Cam Systems:

3. A cam drive is used for a mechanism that moves an automated textile machining process. The sequence of motion of the cam follower must:

    a. rise outward 24 mm with harmonic motion in 0.2 s,
    b. dwell for 0.3 s,
    c. fall 10 mm with harmonic motion in 0.3 s,
    d. dwell for 0.2 s, fall 14 mm with harmonic motion in 0.2 s,
    e. and then repeat the sequence.

    Determine the required speed of the cam and graphically plot a follower displacement diagram.

4. A plate cam must provide the displacement shown in Figure #3 to a reciprocating offset roller follower. The follower is positioned in the vertical plane, contacting the top of the cam. The offset distance is 0.5 in. to the right of the cam center. The roller diameter is

0.75 in. The cam must have a base circle of 2.0 in. and rotate counterclockwise. Graphically construct the profile and estimate the largest pressure angle.

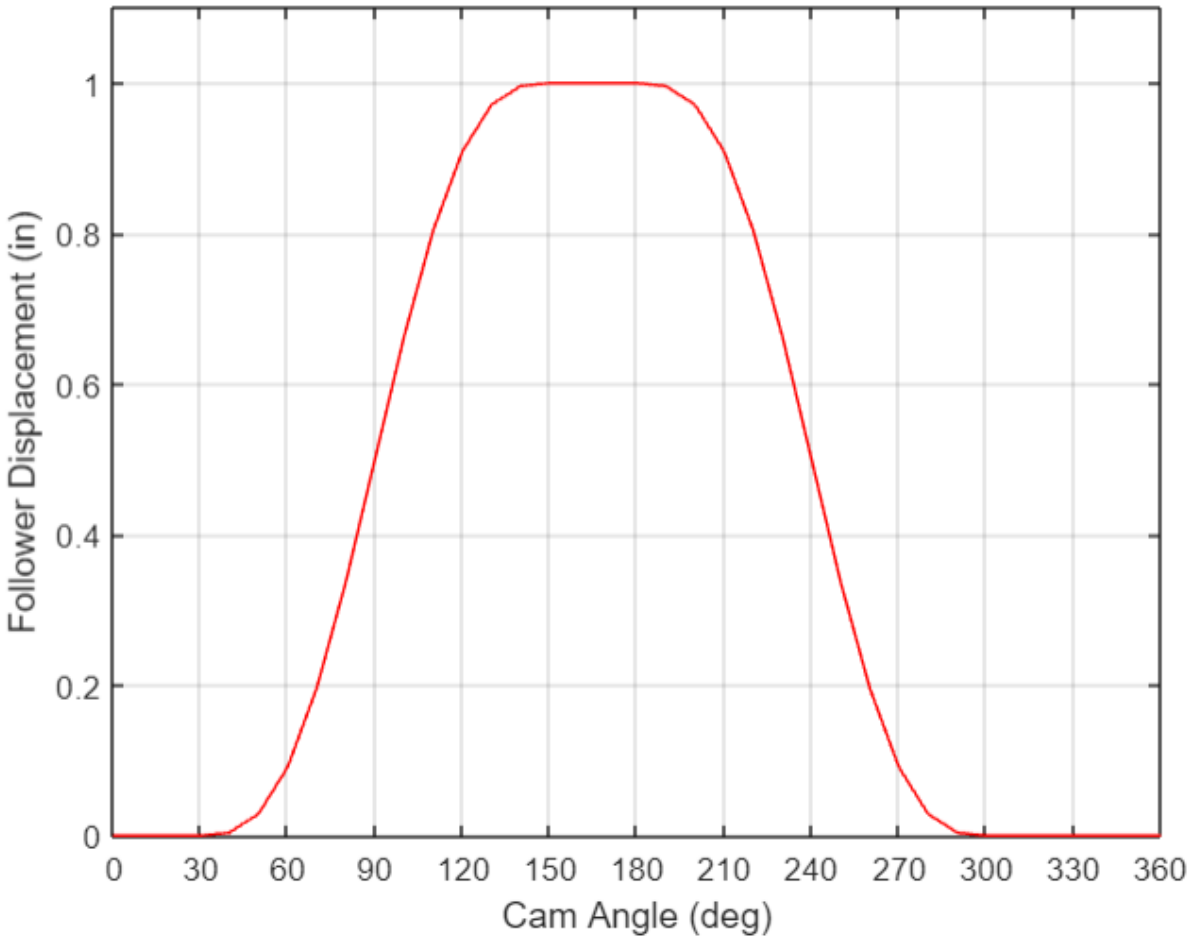


Figure #3 Follower Displacement vs Cam Angle

Script Listing in MATLAB:

```
Cam_Angle = [0 10 20 30 40 50 60 70 80 90 100 110 120 ...
    130 140 150 160 170 180 190 200 210 220 230 240 ...
    250 260 270 280 290 300 310 320 330 340 350 360]; %in degrees


Follower_Disp = [0.000 0.000 0.000 0.000 0.004 0.029 0.091 0.196 ...
    0.337 0.500 0.663 0.804 0.909 0.971 0.996 1.000 1.000 ...
    1.000 1.000 0.996 0.971 0.909 0.804 0.663 0.500 ...
    0.337 0.196 0.091 0.029 0.004 0.000 0.000 0.000 ...
    0.000 0.000 0.000 0.000]; %in inches
```

Gear Geometry & Kinematics:

5. A 25° spur gear with 21 teeth has a metric module of 4. Determine the pitch circle diameter.

6. Two 12-pitch, 20°, full-depth, involute spur gears are used on an industrial circular saw for cutting. The pinion has 18 teeth, and the gear has 42. Determine the following:

    a. The center distance.
    b. The contact ratio.
    c. Whether interference will occur.
    d. A center distance that reduces backlash from a vendor value of $\frac{0.4}{P_d}$ to an AGMA-recommended value of $\frac{0.1}{P_d}$.