1. With reference to Figure 1, compute the unknown vector for each case below. You MUST sketch an approximate velocity vector diagram for each case.

   a) Given: $R_{BA} = 20 \text{ mm} \angle 135^\circ$

      $V_A = 20 \text{ mm/s} \angle 0^\circ$

      $V_B = 20 \text{ mm/s} \angle 270^\circ$

   Find: $\omega_2$

   b) Given: $R_{BA} = 500 \text{ mm} \angle 120^\circ$

      $V_A = 100 \text{ mm/s} \angle 0^\circ$

      $\omega_2 = \pi/2 \text{ rad/s} \text{ ccw}$

   Find: $V_B$
2. In Figure 1 on the previous page, show the location of the instant center of velocity of the body with respect to the fixed coordinate system. Assume that the figure has been drawn to scale.

3. Compute the velocity of point B given:
   i. \( \mathbf{R}_A = 42.4 \text{ mm} \angle 45^\circ \)
   ii. \( \mathbf{R}_{BA} = 50.0 \text{ mm} \angle 323.1^\circ \)
   iii. \( \mathbf{R}_{BC} = 80.0 \text{ mm} \angle 90.0^\circ \)
   iv. \( \omega_2 = \pi/2 \text{ rad/s ccw} \)

   You MUST sketch an approximate velocity vector diagram.

Figure 2. Crank-Rocker Mechanism
Question 3 cont’d
The “Sizzler” is a carnival ride in which nine seats – each holding two or three people – are rigidly mounted on the arms of three spiders. The centers of each of these three spiders rotate on the ends of the arms of a bigger spider, which is also rotating.

4. What acceleration is experienced by a rider at point B when the ride first starts up if:
   \( R_{A0} = 15 \text{ ft} \quad R_{BA} = 10 \text{ ft} \)
   \( \omega_2 = \omega_3 = 0 \)
   \( \alpha_2 = \pi/20 \text{ rad/s}^2 \quad \alpha_3 = \pi/10 \text{ rad/s}^2 \)

   a) when \( \theta_2 = \theta_3 = 0 \)?
   b) when \( \theta_2 = 0; \quad \theta_3 = \pi/2 \text{ rad} \)?
5. What velocity is experienced by a rider at point B when the ride is underway if:

\[ R_{A0} = 15 \text{ ft} \quad R_{BA} = 10 \text{ ft} \]
\[ \omega_2 = \pi/4 \text{ rad/s} \quad \omega_3 = \pi/2 \text{ rad/s} \]
\[ \alpha_2 = \alpha_3 = 0 \]

a) when \( \theta_2 = \theta_3 = 0 \)?
b) when \( \theta_2 = 0; \quad \theta_3 = \pi/2 \text{ rad} \)?
6. What acceleration is experienced by a rider at point B when the ride is underway if:

\[ R_{A0} = 15 \text{ ft} \quad R_{BA} = 10 \text{ ft} \]
\[ \omega_2 = \pi/4 \text{ rad/s} \quad \omega_3 = \pi/2 \text{ rad/s} \]
\[ \alpha_2 = \alpha_3 = 0 \]

a) when \( \theta_2 = \theta_3 = 0? \)
b) when \( \theta_2 = 0; \quad \theta_3 = \pi/2 \text{ rad}? \)
A slim laptop computer is placed on a frictionless floor leaning against a frictionless wall as shown.

7. What are the accelerations of points A, B, and C if the motion starts from rest?

Note: From dynamic analysis: \( \alpha_2 = -\frac{(3/2)g \cos \theta_2}{d} \)
where: \( \alpha_2, \theta_2, \) and \( d \) are as shown in the figure, \( g \) is the gravitational acceleration, and \( C \) is assumed to be the center of mass.
8. What are the velocities of points A, B, and C the moment before the laptop hits the floor?

Note: Assume \( \omega_2 = \omega_{2,0} - (3/2) g (\sin \theta_2 - \sin \theta_{2,0}) / d \).

where \( \theta_2 \), \( \omega_2 \), and \( d \) are shown in the lower figure, \( g \) is the acceleration of gravity and \( \omega_{2,0} \) and \( \theta_{2,0} \) are the initial conditions from the previous page.
Assume that B stays touching the wall.
9. What are the accelerations of points A, B, and C the moment before the laptop hits the floor?

Notes: 1. Use the same equation again: \( \alpha_2 = -\frac{(3/2)g \cos \theta_2}{d} \)
where: \( \alpha_2, \theta_2, \) and \( d \) are as shown in the figure, and \( g \) is the gravitational acceleration.
2. Use any required velocities from the previous page.
3. Assume that B stays touching the wall.
10. A circular platform spins about its center at a constant rate of:

\[ \omega_2 = 24 \text{ RPM}. \]

Riding on the platform a rectangular object at point A moves toward the center at a constant rate:

\[ V_{A3/2} = 1 \text{ m/s} \angle 180^\circ. \]

What is the acceleration of point A with respect to the ground coordinate system \((AA_1/a)\) at the moment in time when \(A_3\) is directly to the right of \(O_2\) by 3 m; i.e. when:

\[ R_{A3/1} = 3 \text{ m} \angle 0^\circ? \]