Problem. The velocity of point A on link (3) is \( V_A = 2.0 \) units/sec in the direction shown. The angular velocity of link (3) is \( 1.5 \) rad/sec CCW. Link (6) forms a sliding joint with link (3) having a slip velocity \( V_{DE} = 1.0 \) units/sec in the direction shown. What is the velocity of point D on link (6)?

Problem. The acceleration of point B on link (2) is \( A_B = 2.0 \) units/sec\(^2\) in the direction shown. The angular velocity and acceleration of link (2) are \( \omega_2 = 0.8 \) rad/sec CW and \( \alpha_2 = 1.0 \) rad/sec\(^2\) CCW. Link (4) forms a sliding joint with link (2) having a slip velocity \( V_{DE} = 1.2 \) units/sec and a slip acceleration \( A_{DE} = 1.8 \) units/sec\(^2\) in the directions shown.

(a) What is the acceleration of point C on link (2)?

(b) What is the acceleration of point D on link (4)?

Problem. Two links of a mechanism connected by a pin joint are shown. Link AB has a length of 5.0 units and link BC has a length of 3.0 units. The velocity of point A is 2.0 units/sec in the direction shown. The axis of the velocity of point C is shown. The angular velocity of link (3) is 1.0 rad/sec CCW.

(a) Construct the velocity polygon.

(b) Show the velocity of point B on the polygon.

(c) Show the velocity of point C on the polygon.

(d) Determine the angular velocity of link (6).
**Problem.** For a four-bar mechanism the following lengths are given:

\[ O_2 A = 1.0, \ AB = 3.6, \ O_4 B = 2.0 \] (any units)

In the shown configuration, the angular velocity of link (2) is \[ \omega_2 = 1.0 \ \text{rad/sec CCW} \].

(a) Construct the velocity polygon.
(b) Determine the angular velocity of links (3).
(c) Determine the angular velocity of links (4).
(d) Determine the velocity of point C on link (3).

**Problem.** For a four-bar mechanism the following lengths are given:

\[ O_2 A = 1.0, \ AB = 3.6, \ O_4 B = 2.0, \ O_2 O_4 = 2.0 \] (any units)

In the shown configuration, the angular velocities are determined to be

\[ \omega_2 = 1.0 \ \text{CW}, \ \omega_3 = 0, \ \omega_4 = 0.5 \ \text{CCW} \]

The angular acceleration of link (2) is zero.

(a) Construct the acceleration polygon.
(b) Determine the angular acceleration of links (3) and (4).
(c) Show the acceleration of point C on the polygon.

**Problem.** For this four-bar mechanism, the link lengths are: \[ O_2 A = 5, \ AB = 20, \ O_4 B = 15 \] units.

In the given configuration, a velocity analysis has determined the angular velocities to be

\[ \omega_2 = 1.0, \ \omega_3 = 0.27, \ \omega_4 = 0.14 \ \text{rad/sec (all CCW).} \]

For \[ \alpha_2 = 1.0 \ \text{rad/sec}^2 \ \text{CW} \):

(a) Construct the acceleration polygon.
(b) Determine the angular acceleration of link (3).
(c) Determine the acceleration of point P.
Problem. In this four-bar mechanism, link (2) rotates with an angular velocity of 1 rad/sec CCW. Consider the following lengths: \( R_{AO_2} = 1 \), \( R_{AB} = 4 \), \( R_{BO_4} = 2 \), and \( R_{PA} = 2 \) units of length.

(a) Construct the velocity polygon. (A convenient point for the origin of the velocities is given.)
(b) Show the velocity vector for point \( P \) on the polygon. Write the magnitude next to the vector.
(c) Determine the angular velocities of links (3) and (4) (magnitude and direction).

Problem. In this four-bar mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW.
(a) Construct the velocity polygon and show the velocity vector for point \( P \) on the polygon.
(b) Determine the angular velocities for links (3) and (4).

Problem. In this four-bar mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW. Assume the length of this link is 1 unit.
(a) Construct the velocity polygon and show the velocity vector for point \( P \) on the polygon.
(b) Determine the angular velocities for links (3) and (4); magnitudes and directions.
**Problem.** In this four-bar mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW. The angular acceleration of this link is 1 rad/sec^2 CW.
(a) Construct the velocity polygon and show the velocity vector for point P on the polygon.
(b) Determine the angular velocities for links (3) and (4).
(c) Construct the acceleration polygon and show the acceleration vector for point P on the polygon.
(d) Determine the angular accelerations for links (3) and (4).

**Problem.** In this four-bar mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW and an angular acceleration of 0.5 rad/sec^2 CW. The lengths of the three moving links are: \( \ell_2 = 1.0, \ell_3 = 2.5, \ell_4 = 1.5 \) (any units).
(a) Construct the velocity polygon and show point P on the polygon.
(b) Determine angular velocities of links (3) and (4).
(c) Construct the acceleration polygon and show point P on the polygon.
(d) Determine angular accelerations of links (3) and (4).

**Problem.** In this four-bar mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW. The angular acceleration of this link is 1 rad/sec^2 CW.
(c) Construct the velocity polygon and show the velocity vector for point P on the polygon.
(d) Determine the angular velocities for links (3) and (4).
(e) Construct the acceleration polygon and show the acceleration vector for point P on the polygon.
(f) Determine the angular accelerations for links (3) and (4).

**Problem.** For this slider-crank mechanism the following constant lengths are given:
\( O_2O_4 = 5.0, AO_2 = 2.0, AC = 2.0, AB = 6.0 \)
(any units of length)
The crank, link 2, rotates with an angular velocity of 1.0 rad/sec, CW. For the shown configuration:
(a) Construct the velocity polygon.
(b) Determine the angular velocity of link 3.
(c) Determine the velocity of points B and C.
**Problem.** For this slider-crank mechanism, $O_2B = 1.0$ unit and in the given configuration $BO_4 = 2.0$ units. The velocity polygon is provided without all the labels. The magnitudes of the velocities are stated (units/sec) on the polygon. An acceleration analysis has revealed that for $\alpha_2 = 1.0 \text{ rad/sec}^2 \text{ CCW}$, $\alpha_3 = 0.3 \text{ rad/sec}^2 \text{ CCW}$. Determine: $\omega_3$, $A^n_{BO_4}$, $A^v_{BO_4}$ and $A^a_{BO_4}$.

**Problem.** For this slider-crank mechanism the following constant lengths are given: $O_2O_4 = 5.0$, $AO_2 = 2.0$, $AC = 2.0$, $AB = 6.0$ (any units of length) The crank, link 2, rotates with an angular velocity of $2.0 \text{ rad/sec}$, CCW, and an angular acceleration of $1.5 \text{ rad/sec}^2$, CW. For the shown configuration a velocity analysis has provided the following velocities: $\omega_3 = -0.8 \text{ rad/sec}$, and $V_{AO_4}^s = 3.0 \text{ units/sec}$ in the direction shown. The acceleration polygon is shown without labels or arrows.
(a) Turn the lines in the acceleration polygon to arrows and label them.
(b) Determine the angular acceleration of link 3.
(c) Determine the acceleration of point $B$.
(d) What is the magnitude of the slip acceleration?

**Problem.** Determine the angular velocity of link (4) if the angular velocity of link (2) is $1 \text{ rad/sec} \text{ CW}$. (Use any method you prefer.)
Problem. For this slider-crank mechanism the following constant lengths are given:

\[ O_2O_4 = 5.0, \quad AO_2 = 2.0, \quad AC = 2.0, \quad AB = 6.0 \]

The crank, link 2, rotates with an angular velocity of 2 rad/sec, CCW, and an angular acceleration of 1 rad/sec^2, CW. The velocity and acceleration polygons are constructed as shown.

a) On the velocity polygon turn the lines into vectors and label the vectors with proper indices.
b) Show \( \mathbf{V}_A \) and \( \mathbf{V}_C \) on the polygon.
c) On the acceleration polygon turn the lines into vectors and label the vectors with proper indices.
d) Show \( \mathbf{A}_A \) and \( \mathbf{A}_C \) on the polygon.

Problem. In this inverted slider-crank mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW. Assume that the length of this link is 1 unit.

(a) Construct the velocity polygon and show on the polygon the velocity vectors for points C and D. (b) Write their magnitudes next to the vectors.

(b) Determine the angular velocities for links (3) and (4); magnitude and direction.

Problem. For this inverted slider-crank mechanism link (2) rotates with an angular velocity of 0.5 rad/sec CCW. Construct the velocity polygon. Assume link (2) has a length of one unit.

(a) Label all the vectors on the polygon.
(b) Determine the angular velocities of links (3) and (4).
(c) Locate point P on the velocity polygon.
Problem. For this slider-crank mechanism the length of link (2) is 1.0 unit and the distance $BA$ in the given configuration is 2.0 units. The velocity polygon is provided without all the labels. The angular velocities are $\omega_2 = 1.0$ rad/sec CCW and $\omega_3 = 0.4$ rad/sec CCW. If link (2) is rotating with a constant angular velocity:
(a) Construct the acceleration polygon
(b) Determine $\alpha_i$
(c) Determine $A''$

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Problem. For this inverted slider-crank, construct the velocity polygon. Assume link (2) rotates with an angular velocity of 1 rad/sec, CCW. Label all the vectors on the polygon. Show the velocity of point $P$ on the polygon.

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Problem. (20 points) For the inverted slider-crank shown, point $B$ is the pin joint and $C_4$ is a point on link 4 coinciding with $B$. The acceleration polygon is given without any labels. On the polygon, convert all the lines into vectors and label them accordingly. Show acceleration of point $P$ on this polygon.
Problem. For this inverted slider-crank mechanism link (2) rotates with an angular velocity of 0.5 rad/sec CCW and an angular acceleration of 0.25 rad/sec² CW. The velocity and acceleration polygons are constructed but there are no labels.

a) Label all the vectors on the velocity polygon.
b) Determine the angular velocities of links (3) and (4).
c) Label all the vectors on the acceleration polygon.
d) Determine the angular accelerations of links (3) and (4).
e) Locate point P on the velocity polygon.
f) Locate point P on the acceleration polygon.

Problem. In this six-bar mechanism link (2) rotates with an angular velocity of 1 rad/sec CCW. Assume that the length of this link is 1 unit.

(a) Construct the velocity polygon and show on the polygon the velocity vectors for points C and D.
(b) Write their magnitudes next to the vectors.
(c) Determine the angular velocities for link (5); magnitude and direction.

Hint: First construct the velocity polygon for the inverted slider-crank $O_2AB(O_4)$, locate point C, and then complete the polygon for the second slider-crank.
Problem. For this six-bar mechanism construct the velocity polygon. Assume link (2) rotates with an angular velocity of 1 rad/sec, CCW. Label all the vectors on the polygon.

<table>
<thead>
<tr>
<th>link</th>
<th>unit</th>
<th>link</th>
<th>unit/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>$O_2A$</td>
<td>1.0</td>
<td>$O_2A$</td>
<td>1.0</td>
</tr>
<tr>
<td>$O_2B$</td>
<td>0.67</td>
<td>$O_2B$</td>
<td>1.08</td>
</tr>
<tr>
<td>$AB$</td>
<td>0.92</td>
<td>$AB$</td>
<td>0.54</td>
</tr>
<tr>
<td>$AC$</td>
<td>1.0</td>
<td>$AC$</td>
<td>1.0</td>
</tr>
<tr>
<td>$BD$</td>
<td>0.79</td>
<td>$BD_6$</td>
<td>1.25</td>
</tr>
<tr>
<td>$CD_5$</td>
<td>0.58</td>
<td>$D_4D_6$</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$CD_5$</td>
<td>1.08</td>
</tr>
</tbody>
</table>

If we construct the acceleration polygon (there is no need to construct it), the polygon will contain a Coriolis component. Determine the magnitude and the direction of this acceleration. The subscripts for this vector must be defined clearly.