Velocity Analysis – Instant Centers

Problem 1. The velocity of point A is $V_A = 2.0$ units/sec in the direction shown. The axis of the velocity of point B is known as shown. What is the angular velocity of this link?

Problem 2. Two links of a mechanism form a sliding joint. Link AB has a length of 10.0 units. In the shown configuration $AC = 6.0$ units. The velocity of point A is 4.0 units/sec in the direction shown. The axis of the velocity of point C is also shown. The angular velocity of link (3) is 0.5 rad/sec CW.
   (a) Locate the instant centers $I_{1,3}$, $I_{1,6}$, and $I_{3,6}$ (link I is the ground).
   (b) Determine the velocity of point B
   (c) Determine the velocity of point C

Problem 3. Two links of a mechanism form a sliding joint. Link AB has a length of 8.0 units. The velocity of point A is 2.7 units/sec in the direction shown. The axis of the velocity of point C is shown. The angular velocity of link (i) is 0.5 rad/sec CW.
   (a) Locate the instant centers $I_{1,i}$, $I_{1,j}$, and $I_{i,j}$ (link I is the ground).
   (b) What is the velocity of point B?
   (c) What is the velocity of point C?
Problem 4. 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 CW. Using the concept of instant centers:

(a) Determine the velocity of point $B$.

(b) Determine the angular velocity of link (6).

(c) Determine the velocity of point $C$.

Problem 5. Some of the instant centers of a six-bar mechanism are found (the mechanism is not shown). Take direct measurements either in centimeters or in inches for the lengths.

(a) Find the instant centers $I_{2,6}$ and $I_{4,5}$.

(b) If the angular velocity of link 3 is 1.0 rad/sec CW, determine the angular velocity of link 6.

(c) Determine the velocity of point $P$ which is attached to link 5. Give the magnitude in either cm/sec or in/sec.
**Problem 6.** The instant centers of a six-bar mechanism are found. The angular velocity of link (3) is 1.0 rad/sec CCW. Use the instant centers to determine:

(a) The angular velocity of link (6).

(b) The velocity of point $P$ on link (5). Assume link (2) has a length of 1.0 unit.

![Diagram of the six-bar mechanism with instant centers marked.](Image)

**Problem 7.** Some of the instant centers of a six-bar mechanism are found (the mechanism is not shown).

(a) Find the instant centers $I_{3,6}$ and $I_{2,5}$.
**Problem 8.** Some of the instant centers of a six-bar mechanism are found. The angular velocity of link (3) is 1.0 rad/sec CW. Use the instant centers to determine the velocity of point \( P \) on link (5). Assume link (2) to have a length of 1.0 unit.

**Problem 9.** For a six-bar mechanism, most of the instant centers are found.

(a) Find the instant center \( 3,6 \).

(b) If the angular velocity of link (3) is 1 rad/sec CCW, find the angular velocity of link (5).

(c) Determine the velocity of point \( P \) which is on link 5. Take direct measurement from the figure for distances. Indicate the unit (for example, inch, cm, or mm) you used for the measurement.
Problem 10. For this six-bar mechanism, some of the instant centers are given.
(a) Find the instant center 2,6.
(b) If a torque of 1 N.m acts on link (2) CCW, what torque on link (6) would keep the mechanism in static equilibrium?

Problem 11. Some of the instant centers of a six-bar mechanism are found (the mechanism is not shown). Find the instant centers $I_{1,4}$ and $I_{3,6}$.
Problem 12. Some of the instant centers of a mechanism are found (the mechanism is not shown). The angular velocity of link (4) is known to be 1 rad/sec CCW. Use the instant centers to determine:

(a) The angular velocity of link (6);  
(b) The velocity of point $P$ on link (6).

Problem 13. Two links of a mechanism and three instant centers are shown in the figure. The velocity of point $B$ on link (3) is known to be 2.0 units/sec in the direction shown. Use the instant centers to determine:

(a) The angular velocity of link (3);  
(b) The angular velocity of link (5);  
(c) The velocity of point $D$ on link (5).
**Problem 14.** Two links of a mechanism and three instant centers are shown in the figure. The velocity of point $B$ on link (6) is known. Use the instant centers to determine:

(a) The angular velocity of link (6);  
(b) The angular velocity of link (4);  
(c) The velocity of point $D$ on link (4).

\[ \mathbf{V}_B = 2.0 \text{ m/s} \]

**Problem 15.** In this six-bar mechanism, some of the instant centers are given. It is assumed that link (2) rotates with an angular velocity of 1 rad/sec CCW. Select an appropriate set of instant centers and determine the angular velocity of link (5) and the velocity of point $P$ on link (5). Take direct measurements from the figure. State the units used for the measurements.
Problem 16. Three links of a mechanism and five instant centers are shown in the figure. The velocity of point $B$ on link (4) is known. Use the instant centers to determine:
(a) The angular velocity of link (4);  
(b) The angular velocity of link (6);  
(c) The angular velocity of link (3);  
(d) The velocity of point $D$ on link (3);  
(e) The instant center 3,6.

\[ V_B = 2.0 \text{ m/s} \]

Problem 17. For this six-bar mechanism, some of the instant centers are already found.
(a) Find the instant center 2,5.
(b) The velocity of point $B$ on link (3) is known as shown (assume 1 unit/sec). Determine the velocity of point $P$ on link (6). Show this vector on the figure and write its magnitude next to it.
Problem 18. For this six-bar mechanism, some of the instant centers are already found.
(a) Find the instant center (3, 6).
(b) Link (2) has an angular velocity of 1 rad/sec CW. Determine the velocity of link (6). Show this vector on the figure and write its magnitude next to the vector.
(c) Determine the angular velocity of link (5), both magnitude and direction.
Problem 19. For this six-bar mechanism, some of the instant centers are already found.
(a) Find the instant center (3, 5).
(b) Link (2) has an angular velocity of 1 rad/sec CW. Determine the angular velocity of link (5), both magnitude and direction. Which centers did you use?
(c) Determine the velocity of point P on link (5). Show this vector on the figure and write its magnitude next to the vector.
Problem 20. For this six-bar mechanism, some of the instant centers are already found.

a) Find the instant center $3,6$.

b) Link (2) has an angular velocity of 1 rad/sec CW. Determine the velocity of point $P$ on link (5).

Show this vector on the figure and write its magnitude next to it.

If necessary, take direct measurements from the figure. Lengths are in centimeters.
Problem 21. For this six-bar mechanism, some of the instant centers are already found.

c) Find the instant center (3, 5).

d) Link (2) has an angular velocity of 1 rad/sec, CW. Determine the velocity of link (6). Show this vector on the figure and write its magnitude next to the vector.

e) Determine the angular velocity of link (5) both magnitude and direction.
Problem 22. For this six-bar mechanism, some of the instant centers are already found.

f) Find the instant center (3, 6).
g) Link (2) has an angular velocity of 1 rad/sec CW. Determine the velocity of point P on link (5).
   Show this vector on the figure at its correct direction and write its magnitude next to the vector.
h) Determine the angular velocity of link (6), both magnitude and direction.
   If necessary, take direct measurements from the figure.