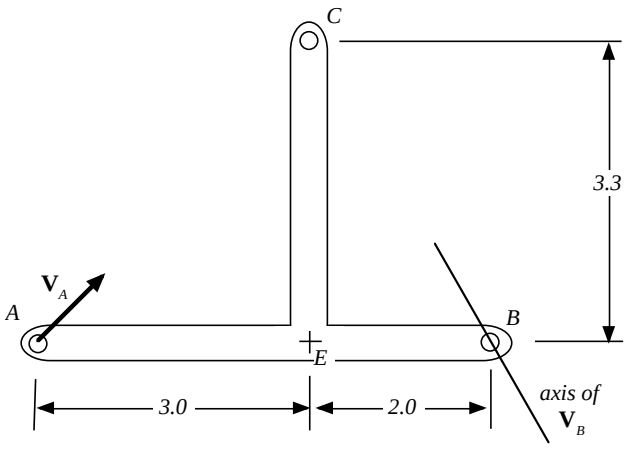
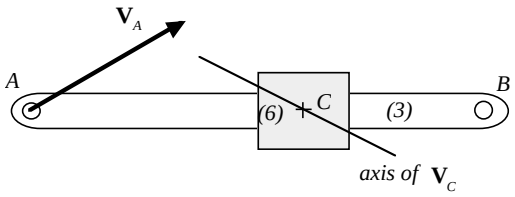
Velocity Analysis – Instant Centers

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?

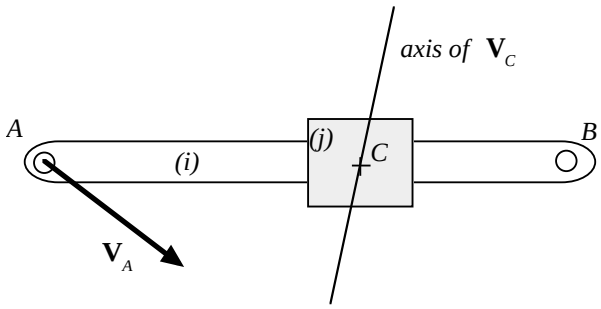


Problem 2. Two links of a mechanism form a sliding joint. Link *AB* has a length of 10.0 units. In the shown configuration $AC = 6.0$ units. The velocity of point *A* is 4.0 units/sec in the direction shown. The axis of the velocity of point *C* is also shown. The angular velocity of link *(3)* is 0.5 rad/sec CW.



(a) Locate the instant centers $I_{1,3}$, $I_{1,6}$, and $I_{3,6}$ (link *1* 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.



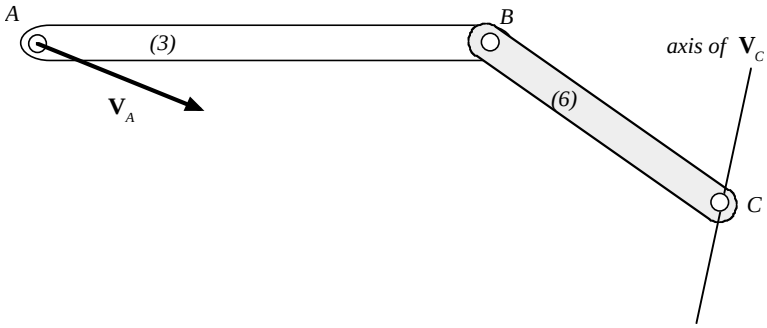
(a) Locate the instant centers $I_{1,i}$, $I_{1,j}$, and $I_{i,j}$ (link *1* is the ground).
(b) What is the velocity of point *B*?
(c) What is the velocity of point *C*?

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*.

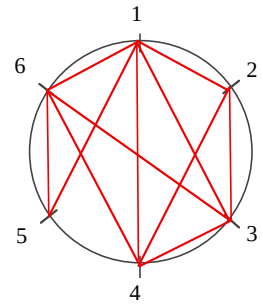


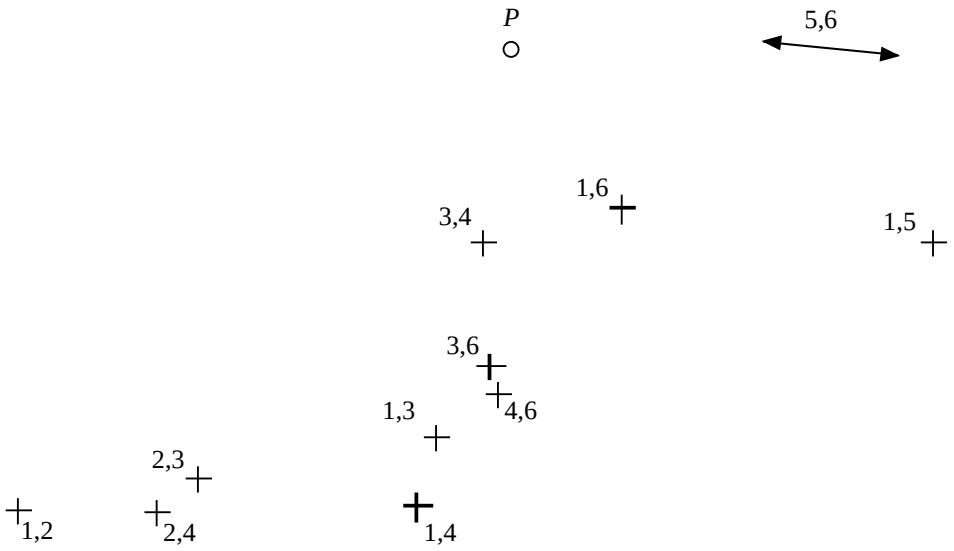
Problem 5 Some of the instant centers of a six-bar mechanism are found (the mechanism is not shown). Take direct measurements either in centimeters or in inches for the lengths.

(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.

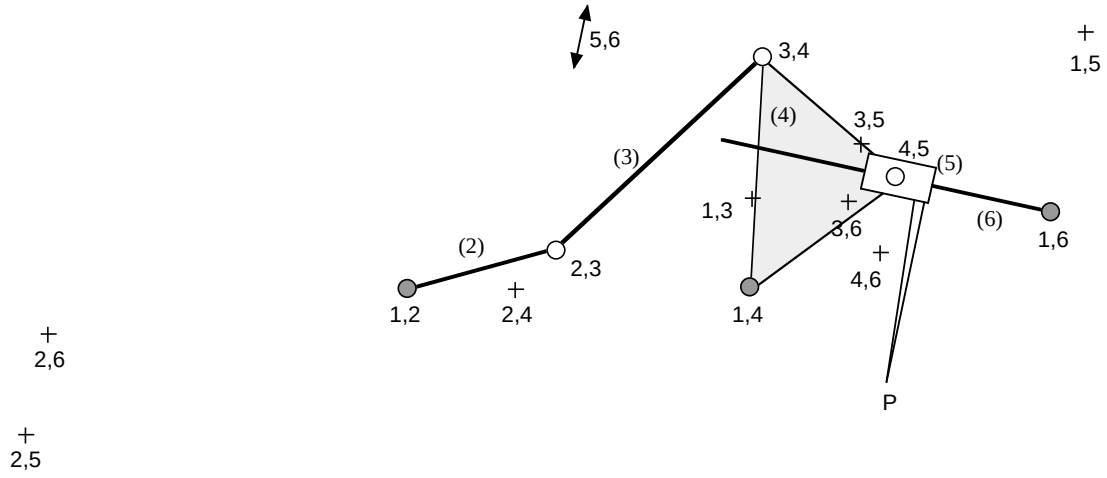




Problem 6. The instant centers of a six-bar mechanism are found. The angular velocity of link *(3)* is 1.0 rad/sec CCW. Use the instant centers to determine:

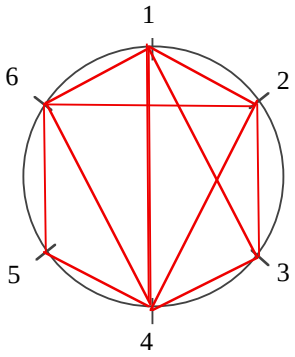
(a) The angular velocity of link *(6)*.

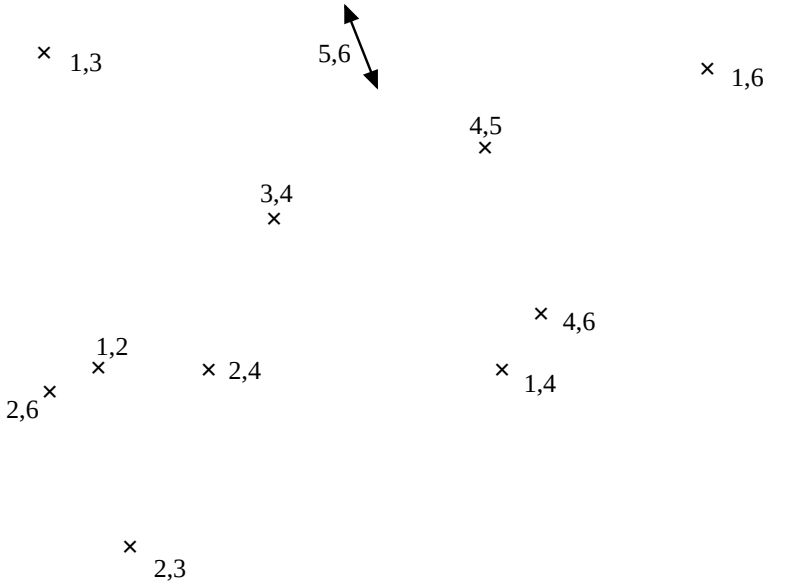
(b) The velocity of point *P* on link *(5)*. Assume link *(2)* has a length of 1.0 unit.



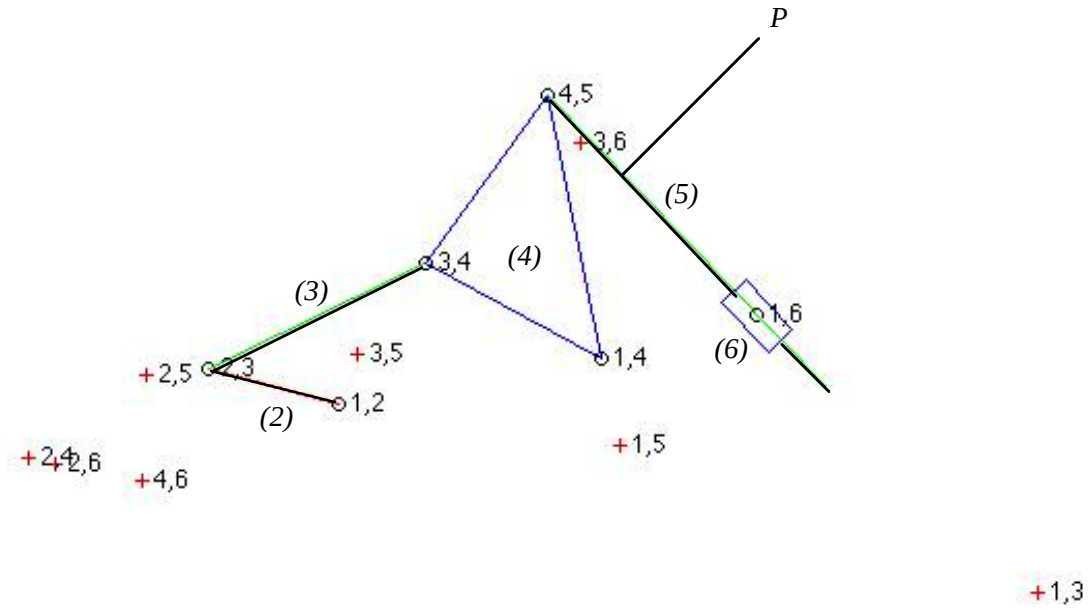
Problem 7. Some of the instant centers of a six-bar mechanism are found (the mechanism is not shown).

(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.

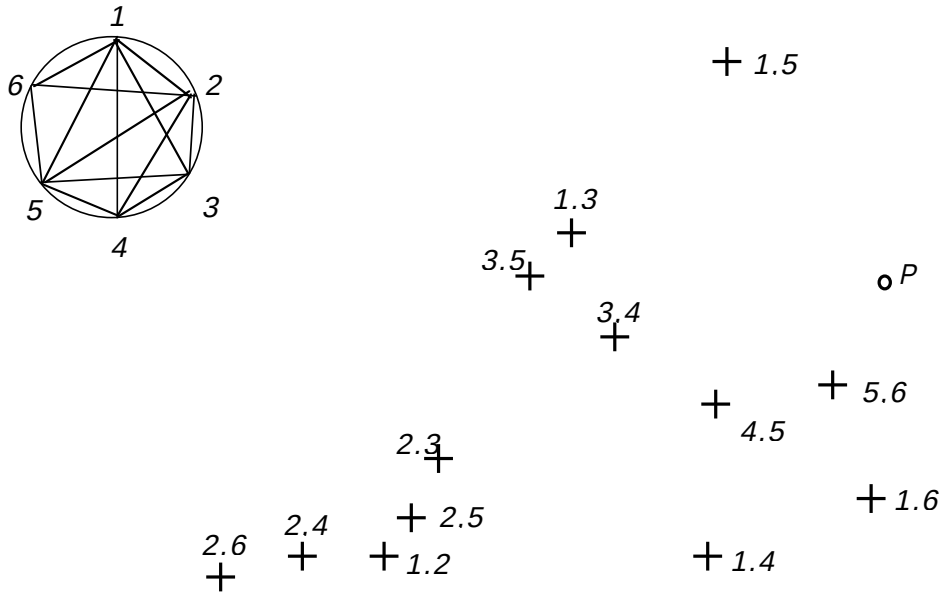


Problem 9. For a six-bar mechanism, most of the instant centers are found.

(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)*.

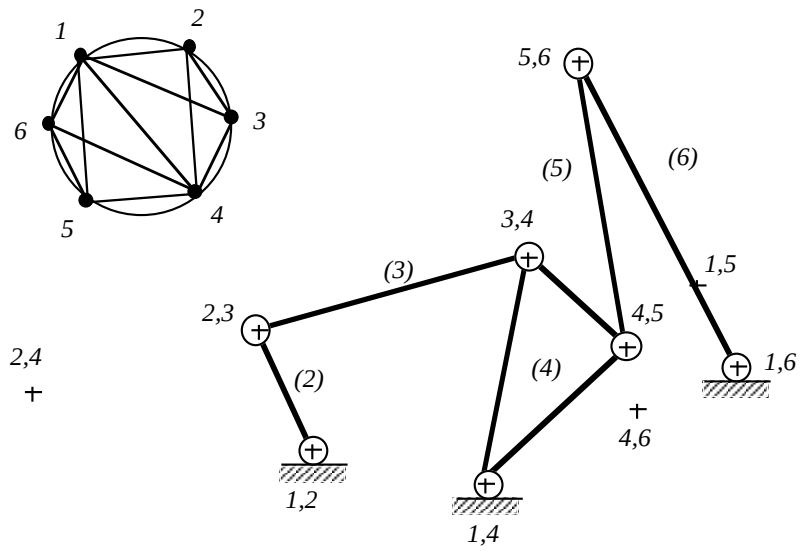
(c) Determine the **velocity** of point *P* which is on link *5*. Take direct measurement from the figure for distances. Indicate the unit (for example, inch, cm, or mm) you used for the measurement.



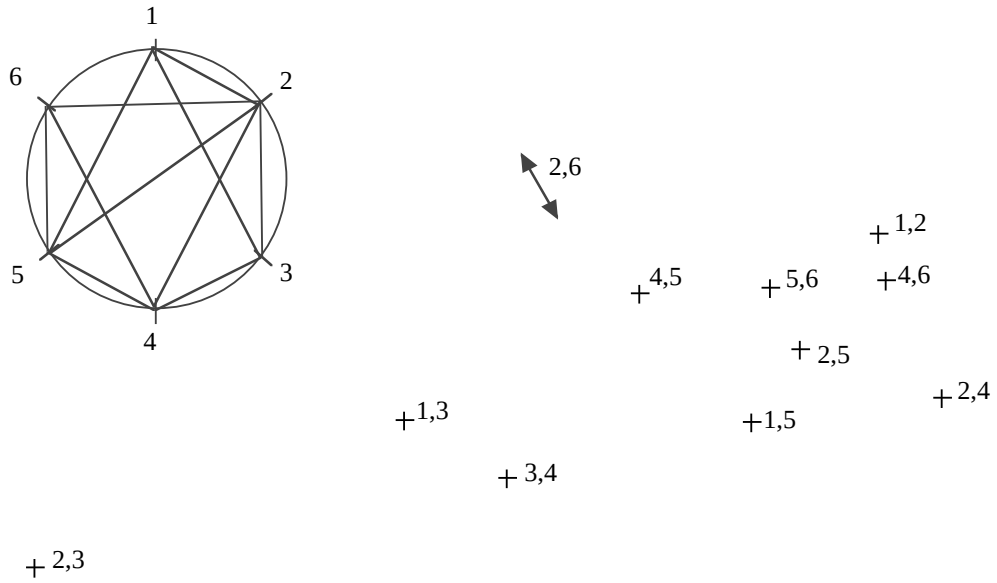
Problem 10. For this six-bar mechanism, some of the instant centers are given.

(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?

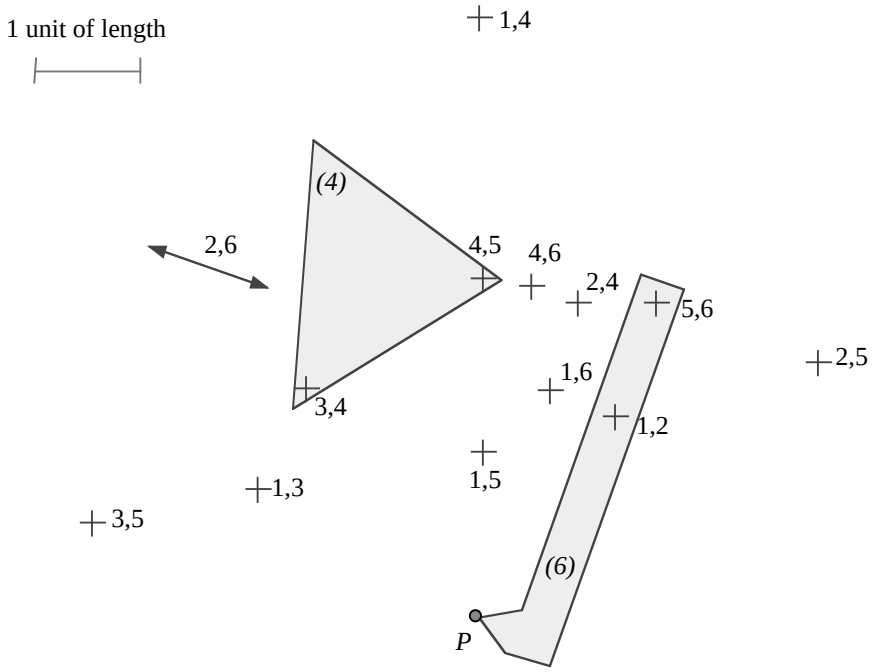


Problem 11. Some of the instant centers of a six-bar mechanism are found (the mechanism is not shown). Find the instant centers $I_{1,4}$ and $I_{3,6}$.



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:

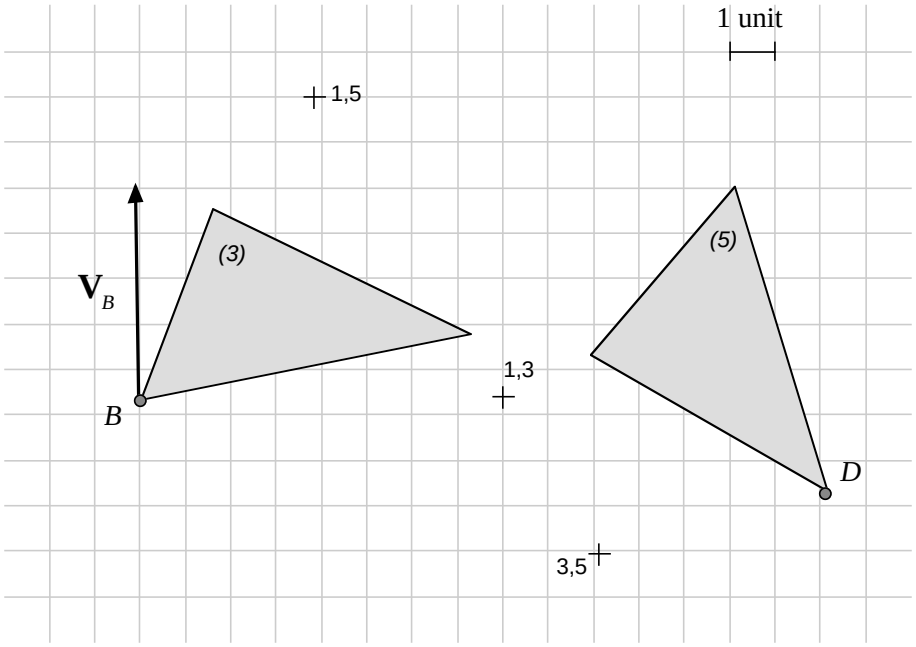
(a) The angular velocity of link *(6)*; (b) The velocity of point *P* on link *(6)*.



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)*;

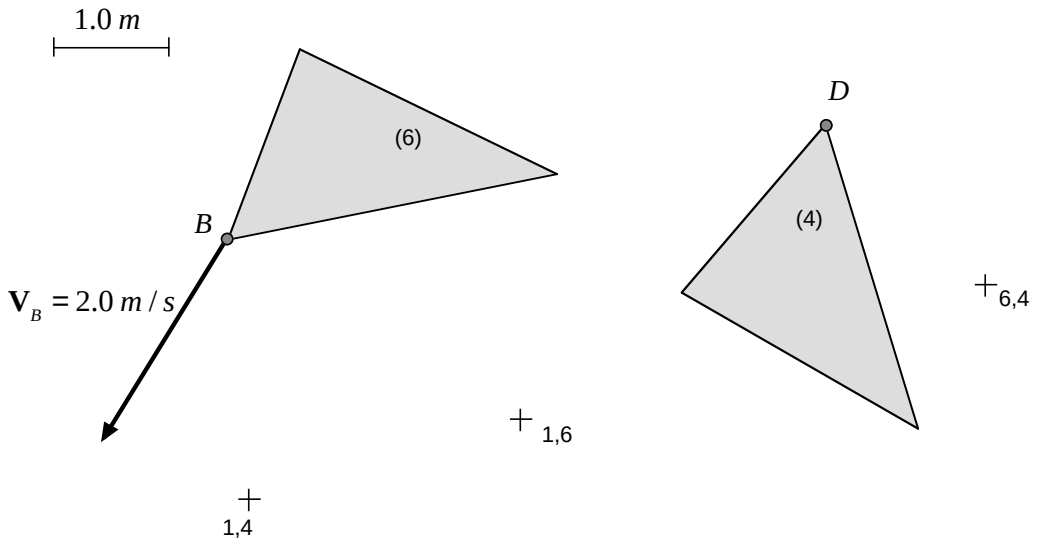
(c) The velocity of point *D* on link *(5)*.



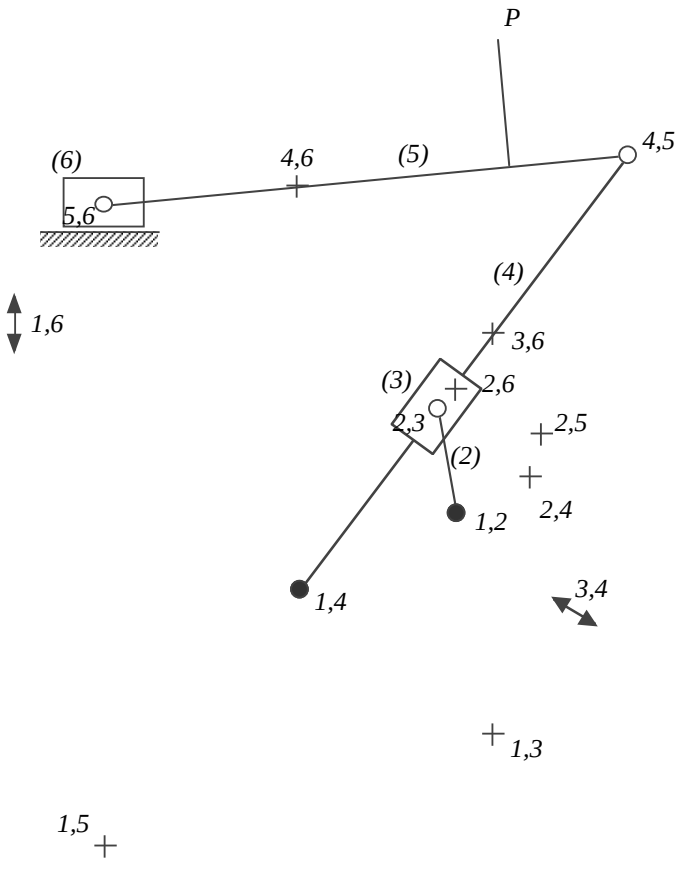
Problem 14. Two links of a mechanism and three instant centers are shown in the figure. The velocity of point *B* on link *(6)* is known. Use the instant centers to determine:

(a) The angular velocity of link *(6)*; (b) The angular velocity of link *(4)*;

(c) The velocity of point *D* on link *(4)*.

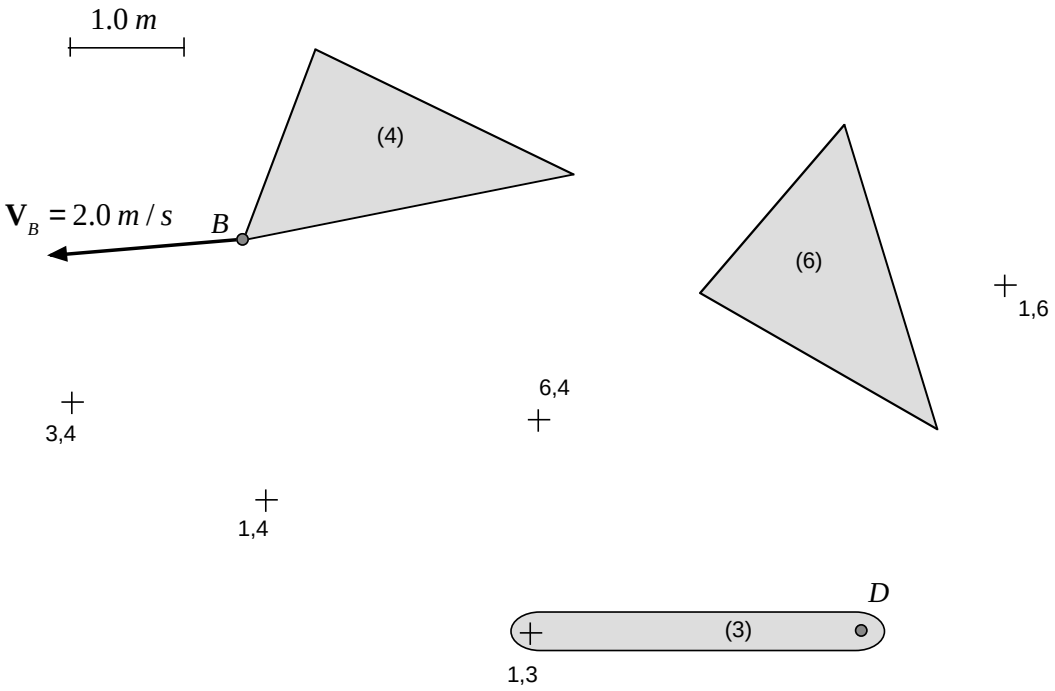


Problem 15. In this six-bar mechanism, some of the instant centers are given. It is assumed that link *(2)* rotates with an angular velocity of 1 rad/sec CCW. Select an appropriate set of instant centers and determine the angular velocity of link *(5)* and the velocity of point *P* on link *(5)*. Take direct measurements from the figure. State the units used for the measurements.



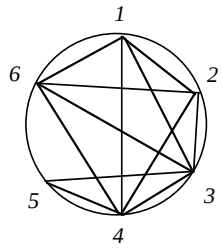
Problem 16. Three links of a mechanism and five instant centers are shown in the figure. The velocity of point *B* on link *(4)* is known. Use the instant centers to determine:

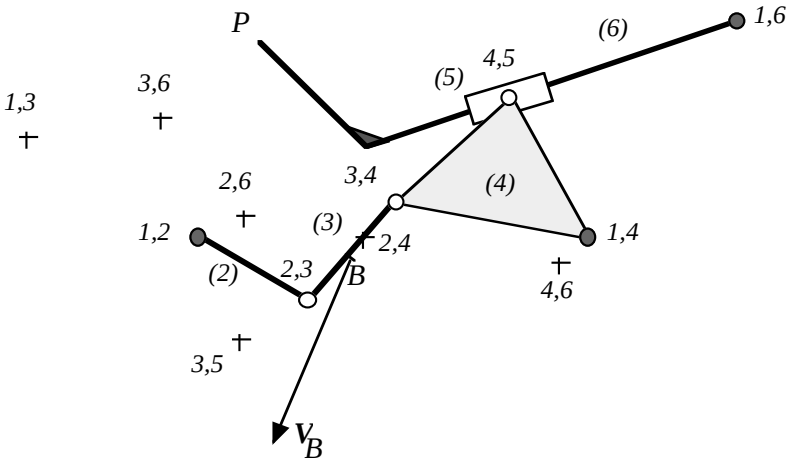
(a) The angular velocity of link *(4)*; (b) The angular velocity of link *(6)*;
(c) The angular velocity of link *(3)*; (d) The velocity of point *D* on link *(3)*;
(e) The instant center *3,6*.



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.



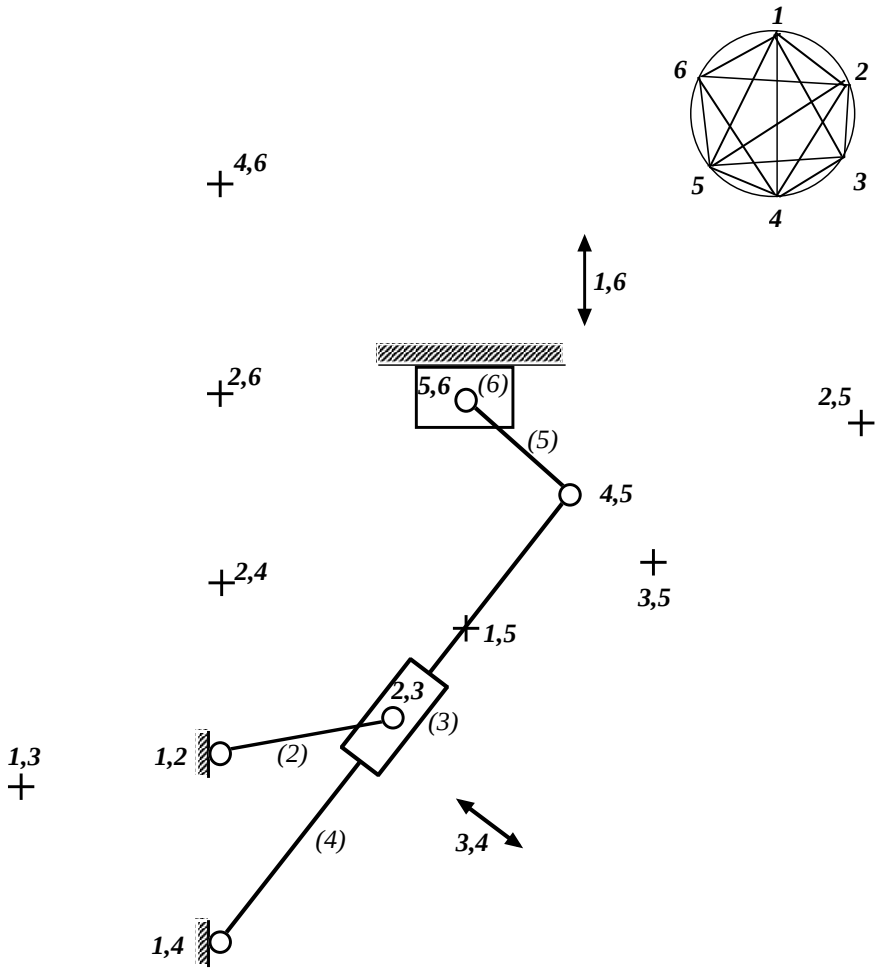


Problem 18. For this six-bar mechanism, some of the instant centers are already found.

(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.

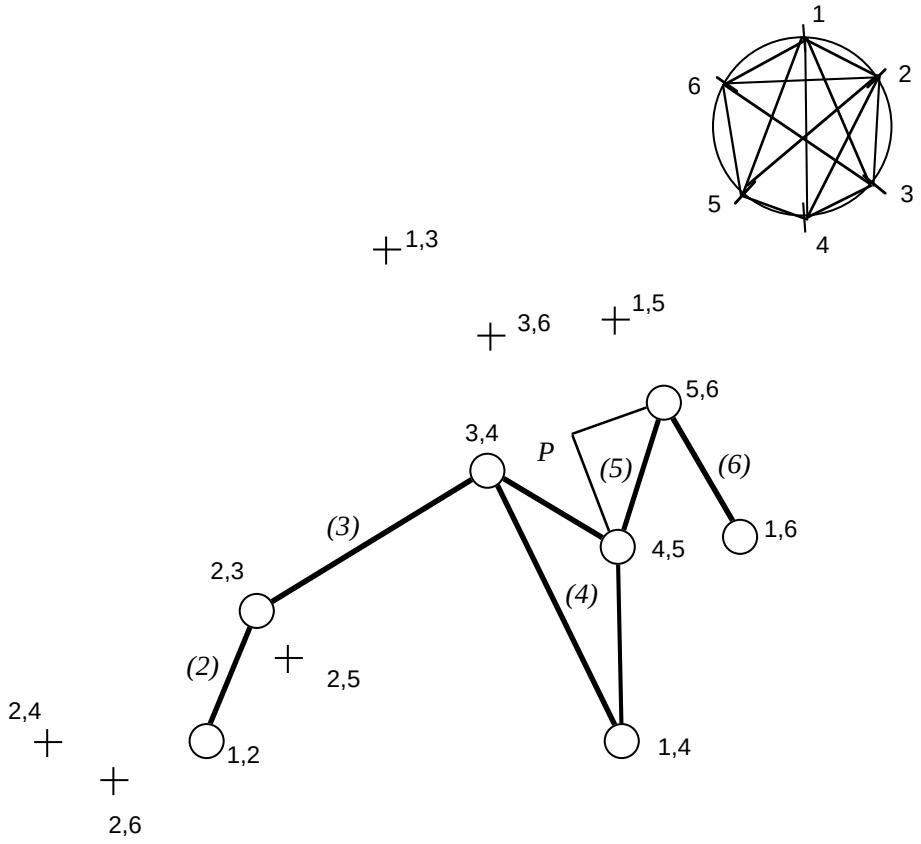


Problem 19. For this six-bar mechanism, some of the instant centers are already found.

(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.

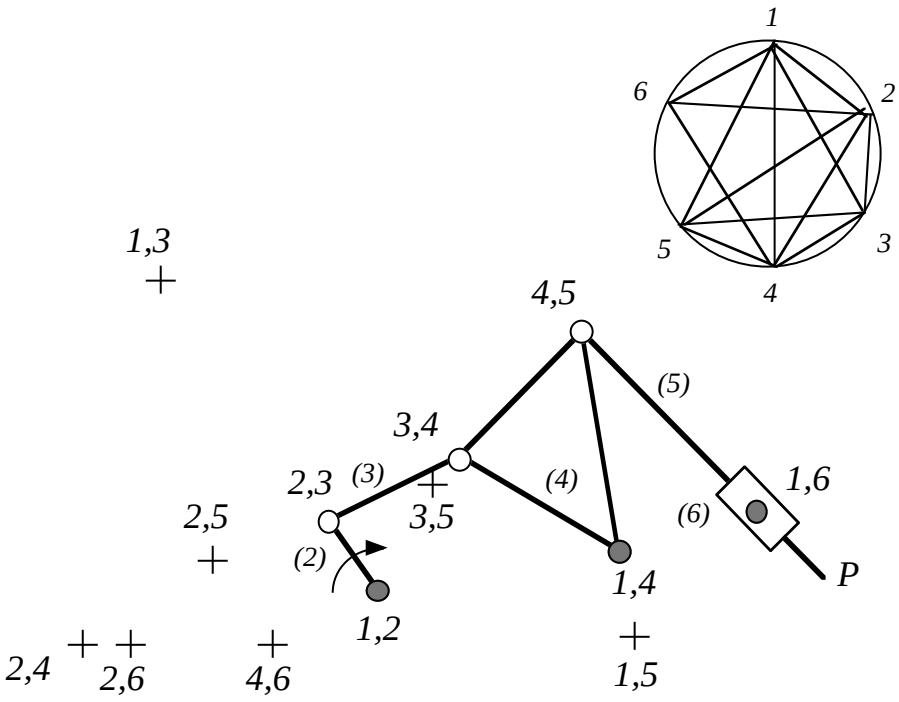


Problem 20. For this six-bar mechanism, some of the instant centers are already found.

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**.

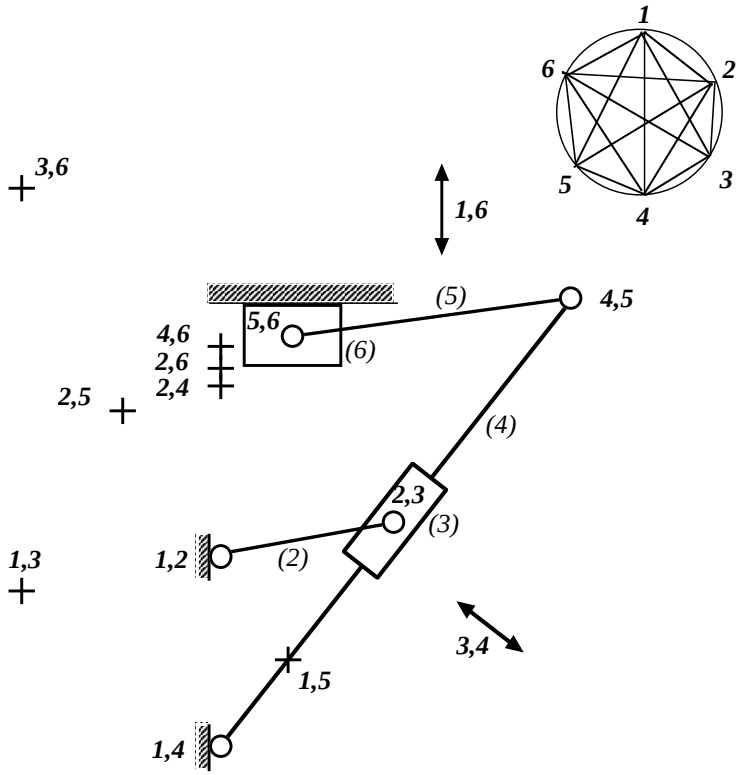


Problem 21. For this six-bar mechanism, some of the instant centers are already found.

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.