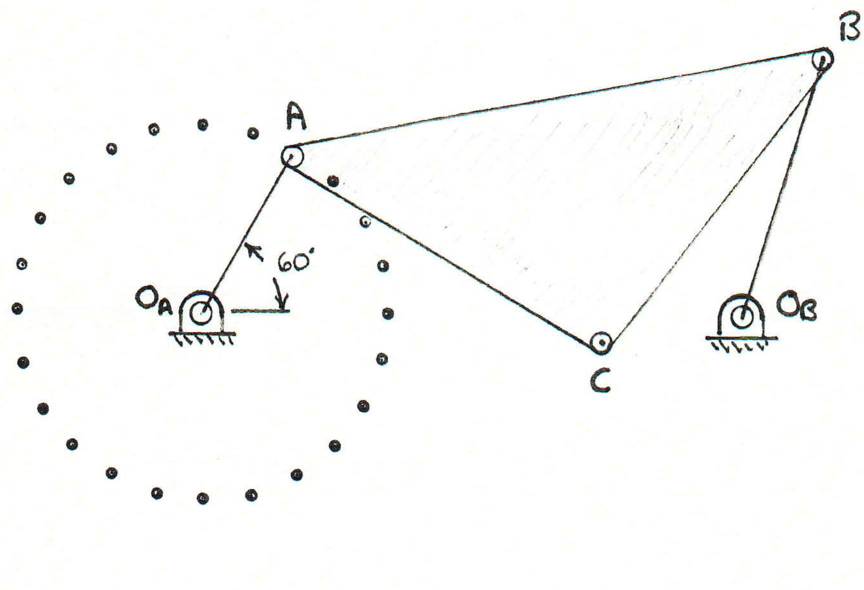
PROB 2.2 | DETERMINE THE PATH OF POINT C USING 15° INCREMENTS OF ROTATION OF LINK 1. ($O_AA=1.0$, $AB=3.0$, $O_BB=1.5$, $O_AO_B=3.0$, $AC=BC=2.0$)

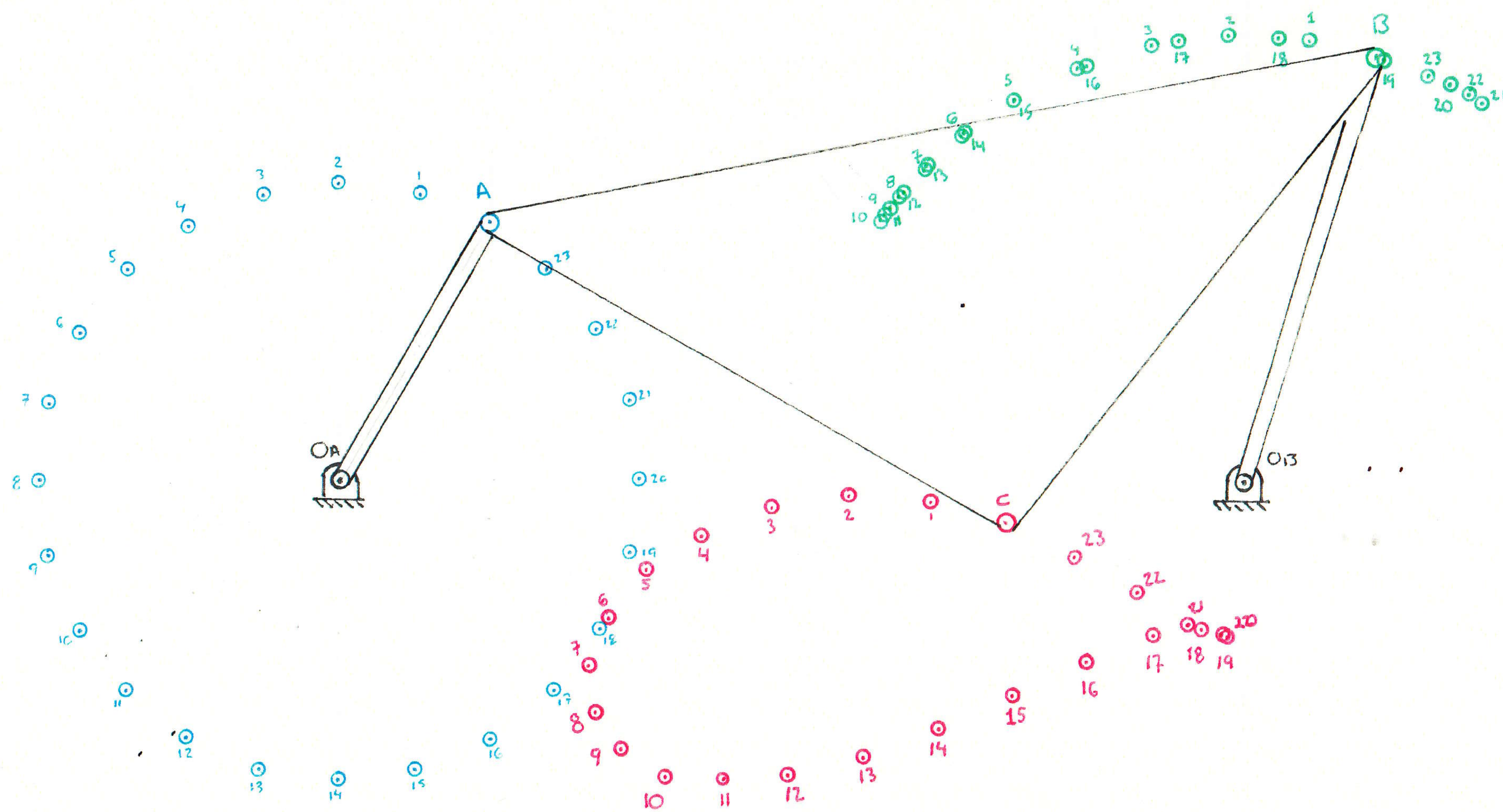
GIVEN:
1. 4-BAR LINKAGE WITH A 3 NODE COUPLER LINK, SHOWN BELOW
2. DRIVE LINK GOING THROUGH 15° INCREMENTS OF ROTATION
3. THE INITIAL ANGLE OF THE DRIVE LINK WITH RESPECT TO THE POSITIVE HORIZONTAL IS 60°
4. $O_AA = 1.0$, $AB = 3.0$, $O_BB = 1.5$, $O_AO_B = 3.0$, $AC = BC = 2.0$

ASSUMPTIONS:
1. ALL LINKS ARE RIGID
2. THE MOTION OF ALL LINKS ARE PLANAR
3. ALL JOINTS ARE FRICTIONLESS
4. THE LINKS DO NOT INTERFER WITH EACH OTHER DURING THE ROTATION.

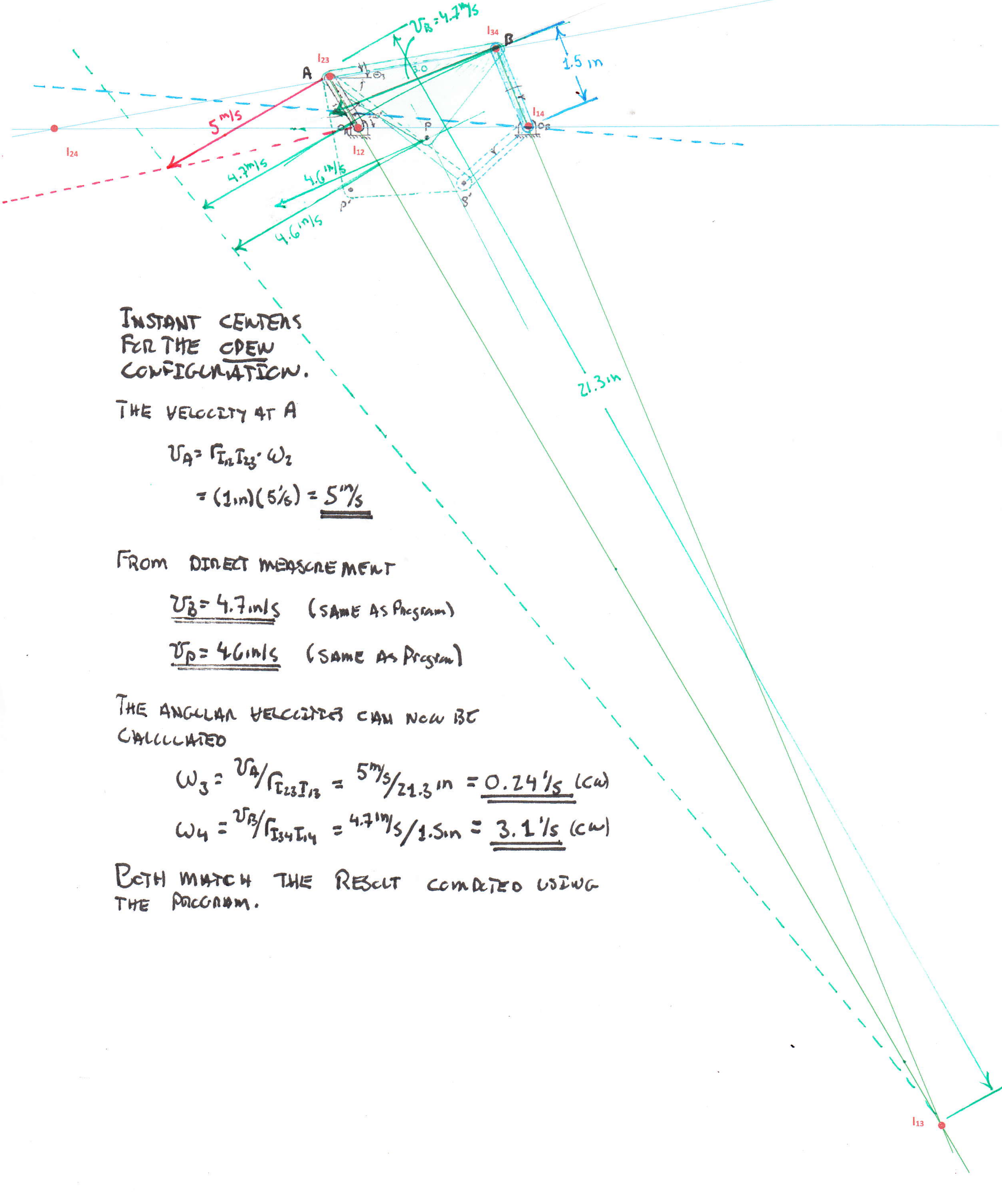
FIND:
1. THE POSITION OF POINT C FOR EACH 15° ROTATION OF THE DRIVE LINK
2. FIND ALL INSTANT CENTERS FOR THE OPEN & CLOSED CONFIGURATIONS WHEN $\theta_2 = 120°$
3. DETERMINE THE LINEAR VELOCITIES OF A, B, & C ALONG WITH THE ANGULAR VELOCITIES ω_3 & ω_4 FOR BOTH THE OPEN AND CLOSED ~~POST~~ CONFIGURATIONS WHEN $\theta_2 = 120°$, $\omega_2 = 5$ r/s

FIGURE:





SUMMARY: THE LOCATION OF "A" IS NUMBERED IN BLUE, "B" IN GREEN, AND "C" IN RED SO THAT THE LOCATIONS OF "A" & "B" FOR CORRESPONDING POSITIONS OF "C" CAN EASILY BE SEEN. AS "A" ROTATES AT A CONSTANT RATE, INDICATED BY EQUAL CIRCUMFERENTIAL SPACING, POINTS "B" AND "C" SPEED UP AND SLOW DOWN, INDICATED BY THE UNEQUAL SPACING OF THE POINTS ON THE PATHS TAKEN BY "B" AND "C".



INSTANT CENTERS FOR THE OPEN CONFIGURATION.

THE VELOCITY AT A

$$v_A = r_{I_{12}I_{23}} \cdot \omega_2$$

$$= (1\,\text{in})(5\,/\text{s}) = \underline{\underline{5\,\text{in/s}}}$$

FROM DIRECT MEASUREMENT

$\underline{\underline{v_B = 4.7\,\text{in/s}}}$ (SAME AS PROGRAM)

$\underline{\underline{v_P = 4.6\,\text{in/s}}}$ (SAME AS PROGRAM)

THE ANGULAR VELOCITIES CAN NOW BE CALCULATED

$$\omega_3 = v_A / r_{I_{23}I_{13}} = 5\,\text{m/s} / 21.3\,\text{in} = \underline{\underline{0.24\,/\text{s}}}\ (\text{cw})$$

$$\omega_4 = v_B / r_{I_{34}I_{14}} = 4.7\,\text{in/s} / 1.5\,\text{in} = \underline{\underline{3.1\,/\text{s}}}\ (\text{cw})$$

BOTH MATCH THE RESULT COMPUTED USING THE PROGRAM.

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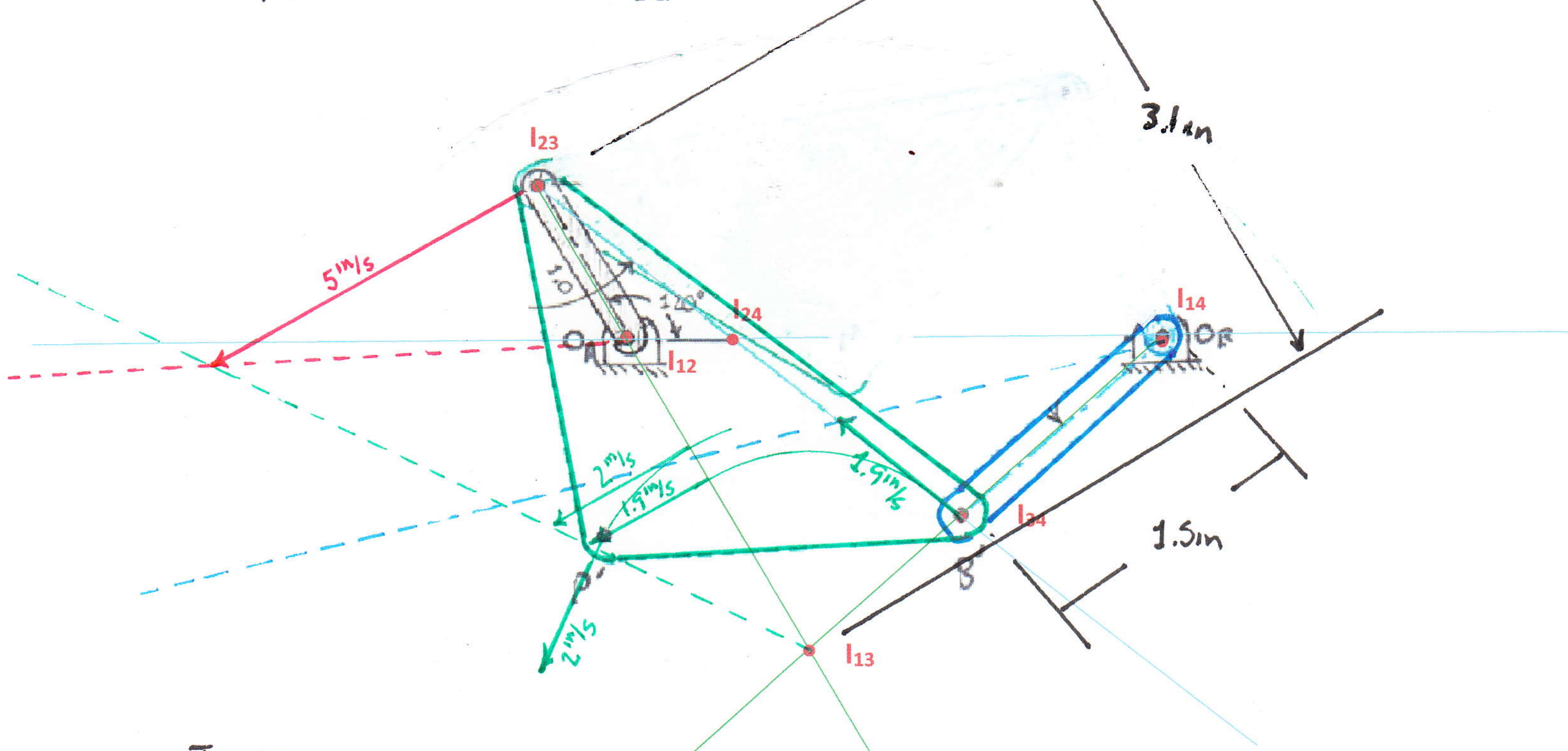
INSTANT CENTERS FOR THE <u>CROSSED/CLOSED</u> SOLUTION



THE VELOCITY AT A IS COMPUTED USING THE ω_2 AND THE DISTANCE TO A.

$$v_A = r_{I_{12}I_{23}} \cdot \omega_2 = r_{O_A A} \cdot \omega_2 = 1\text{ in} \cdot 5\,\tfrac{1}{s} = \underline{\underline{5\ \text{in/s}}}$$

FROM DIRECT MEASUREMENT

$$v_B = \underline{\underline{1.9\ \text{in/s}}}$$

$$v_D = \underline{\underline{2\ \text{in/s}}}$$

BOTH VALUES ARE WITHIN ACCEPTABLE RANGE WHEN COMPARED TO THE PROGRAM GENERATED SOLUTION.

THE ANGULAR VELOCITY OF ω_3 & ω_4 CAN NOW BE COMPUTED.

$$\omega_3 = v_A / r_{AI_{13}} = v_A / r_{I_{23}I_{13}} = 5\ \text{in/s} / 3.1\ \text{in} = 1.6\ \tfrac{1}{s}\ (\text{ccw})$$

$$\omega_4 = v_B / r_{BI_{14}} = v_B / r_{I_{34}I_{14}} = 1.9\ \text{in/s} / 1.5\ \text{in} = 1.3\ \tfrac{1}{s}\ (\text{cw})$$

<u>SUMMARY:</u>

THE IC TECHNIQUE IS LIMITED BY THE PRECISION OF THE DRAFTING TOOLS; HOWEVER, THE RESULTS DO COMPARE WELL WITH THE ANALYTICAL RESULTS