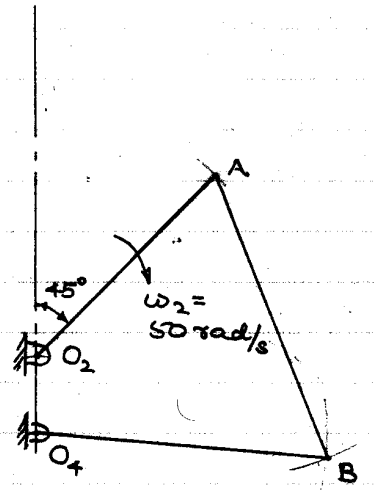
MECH 343/2 X : Theory of Machines I.

Solution to Assignment 5.

1.



$O_2O_4 = 100$ mm

$O_2A = 350$ mm

$AB = 425$ mm

$O_4B = 400$ mm

Scale: 1 cm = 100 mm.

$\vec{v}_B = \vec{v}_A + \vec{v}_{BIA}$

$\vec{ob} = \vec{oa} + \vec{ab}$

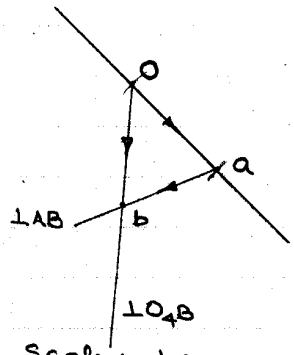
$\perp O_4B$; $\perp O_2A$; $\perp AB$.

$oa = O_2A \cdot \omega_2$

$= 0.350 \times 50$

$= 17.5$ m/s.

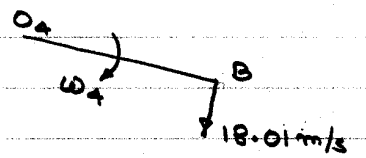
Velocity Polygon:



Scale: 1 cm = 10 m/s.

$ob = 18.01$ m/s.

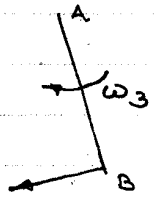
$ab = 15.64$ m/s.



$0.400\ \omega_4 = 18.01$

$\omega_4 = 45.03$ rad/s.

(CW)



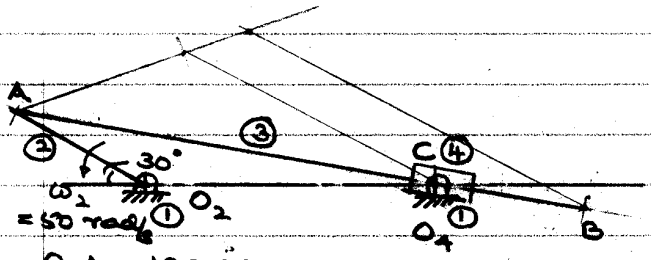
$0.425\ \omega_3 = 15.64$

$\omega_3 = 36.80$ rad/s

(CW)

(2)

Note: C is at O_4. $v_{C_4} = 0$



$O_2A = 100$ mm

$O_2O_4 = O_2C = 200$ mm

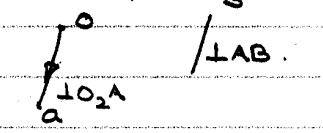
$AB = 400$ mm

Scale: 1 cm = 50 mm.

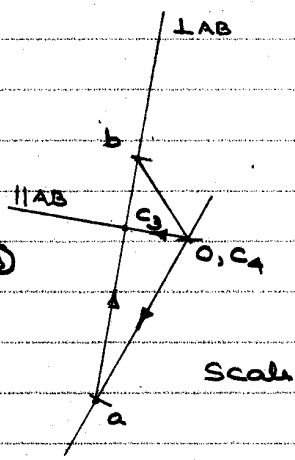
$\vec{v}_{C_3} = \vec{v}_A + \vec{v}_{C_3|A}$

$\vec{OC_3} = \vec{Oa} + \vec{aC_3}$

$\parallel AB$; $\perp AB$; $\perp O_2A$



$Oa = 0.1 \times 50$
$= 5$ m/s



Scale: 1 cm = 2 m/s.

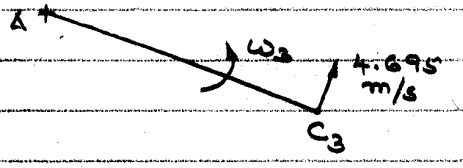
A, C_3, B are points on (3)

$\frac{ab}{aC_3} = \frac{AB}{AC_3}$,

Use construction.

$aC_3 = 4.695$ m/s

$AC = 290.9$ mm



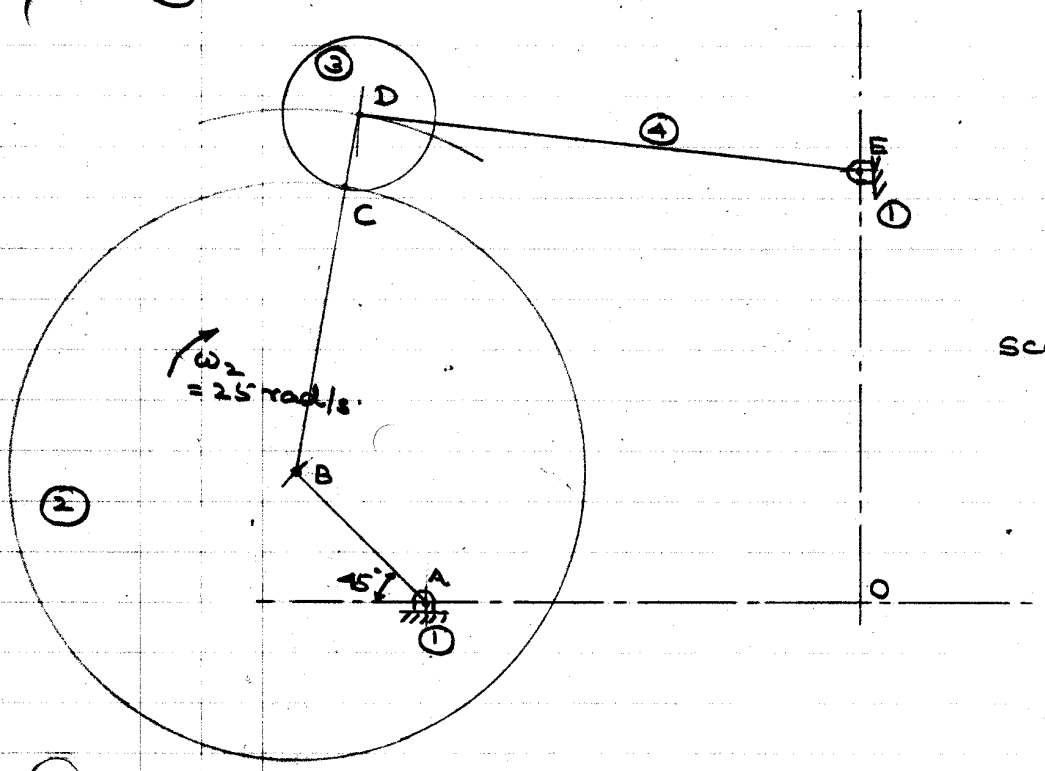
$\omega_3 = \frac{4.695}{0.2909} = 16.14$ m/s.

$Ob = 2.460$ m/s.

65.579°

Note: The answers are calculated values.
For your solution, measured values are acceptable.

(3)



OA = OE = 3"

AB = $1\frac{1}{4}$"

BC = 2"

CD = $\frac{1}{2}$"

DE = $3\frac{1}{2}$"

Scale: 1 cm = $\frac{1}{2}$".

$v_A = 0$

$v_B = 1.25 \times 25$
$= 31.25$ "/s.

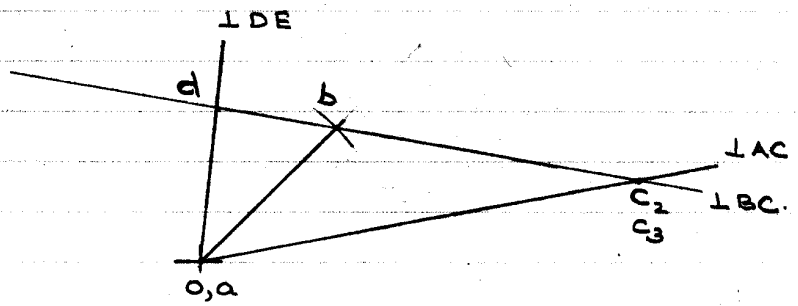
In velocity polygon a is at O.

ob = 31.25"/s ∠45°

A, B, C are points on (2).

$\vec{v}_{C_3} = \vec{v}_{C_2}$

∴ C_3 and C_2 are coincident.

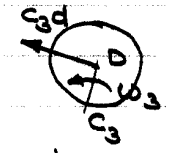


$\vec{v}_D = \vec{v}_{C_3} + \vec{v}_{D|C_3}$

$\vec{od} = \vec{oC_3} + \vec{C_3d}$

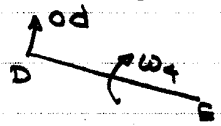
⊥DE ✓ ⊥CD

Locate d.

$\vec{v}_{D|C_3}$: 

$C_3d = 69.81$ "/s

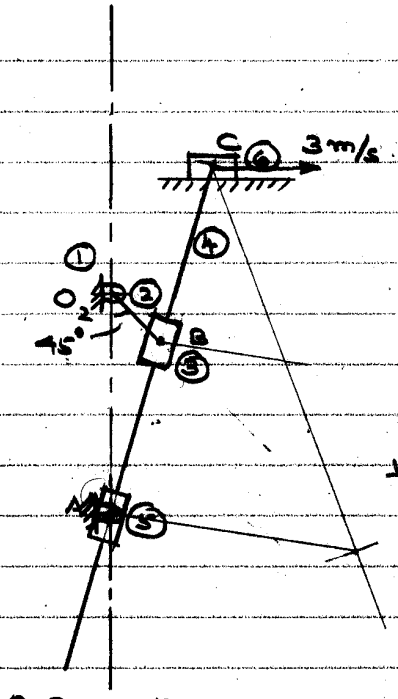
$\therefore \omega_3 = \frac{69.81}{0.5} = 139.6$ rad/s. (CCW)

$\vec{v}_D$: 

od = 25.41"/s.

$\omega_4 = \frac{25.41}{3.5} = 7.26$ rad/s (CW)

4.



$O_2B = 25\ mm$

$O_2A = 75\ mm$

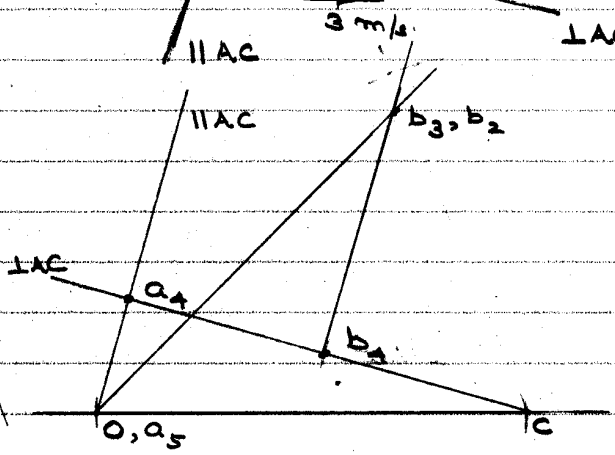
$AC = 125\ mm$

Scale : 1 cm = 25 mm

$\vec{v}_{A_4} = \vec{v}_C + \vec{v}_{A_4/C}$.

$\vec{oa_4} = \vec{oc} + \vec{ca_4}$

3 m/s ⟶ ; $\parallel AC$; $\perp AC$.



Scale: 1 cm = 0.5 m/s

A, B, C are on (4)

$\frac{cb_4}{ca_4} = \frac{CB}{CA}$.

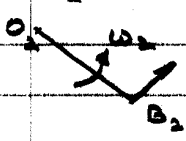
B_3 & B_2 moved together.

$\vec{v}_{B_3} = \vec{v}_{B_4} + \vec{v}_{B_3/4}$

$\vec{ob_3} = \vec{ob_4} + \vec{b_4b_3}$ ✓

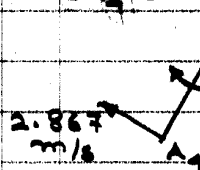
$\perp O_2B$; $\parallel AC$.

$ob_2 = 2.944\ m/s$.



$\therefore \omega_2 = \frac{2.944}{0.025} = 117.8\ rad/s$ (CCW)

$ca_4 = 2.867\ m/s$.



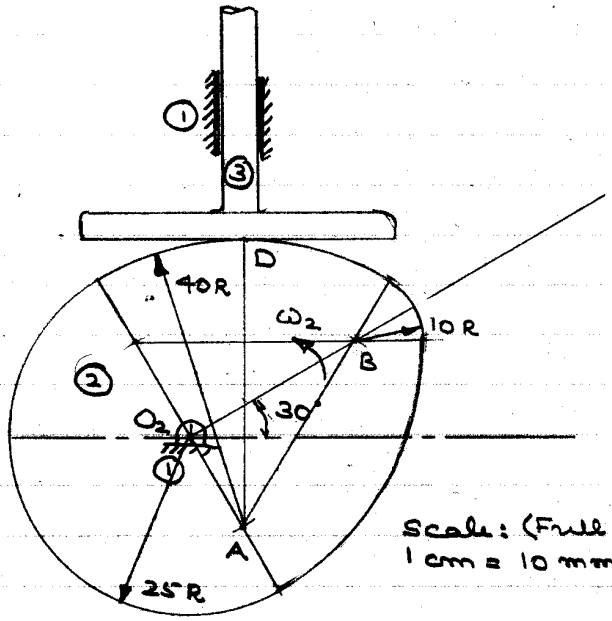
$\omega_4 = \frac{2.867}{0.125} = 22.94\ rad/s$ (CW)

$b_4b_3 = 1.719\ m/s$. Collar (3) slides upward on (4)

$oa_4 = 0.884\ m/s$

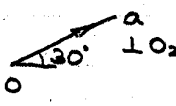
(4) moves upward on collar (5).

5.



$v_A = 0.015 \times 50$
$= 0.75$ m/s.

O_2, A, D are on (2)



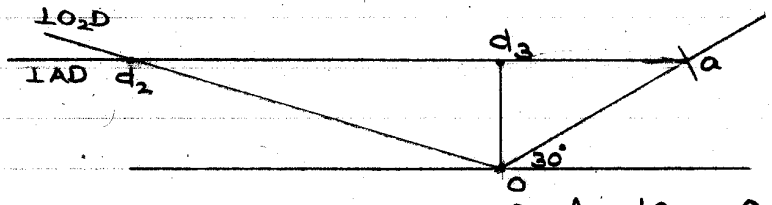
$\vec{v}_{D_3} = \vec{v}_{D_2} + \vec{v}_{D_3D_2}$

$\vec{od}_3 = \vec{od}_2 + \vec{d_2d_3}$

$\vec{od}_3$ ∥ AD ✓ $\vec{d_2d_3}$ ⊥ AD

Scale: (Full Size)
1 cm = 10 mm.

$O_2A = 15$ mm
AD = 40 mm
$\omega_2 = 50$ rad/s

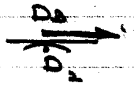


scale : 1 cm = 0.25 m/s

$\vec{v}_{D_3} = \vec{od}_3$ $od_3 = 0.375$ m/s.

∴ Velocity of follower = 0.375 m/s ↑

Velocity of rubbing



$d_3d_2 = 1.351$ m/s.

1.351 m/s.