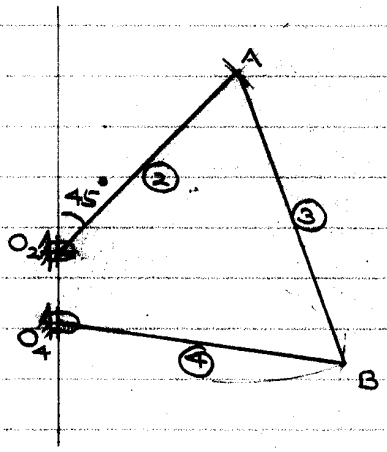
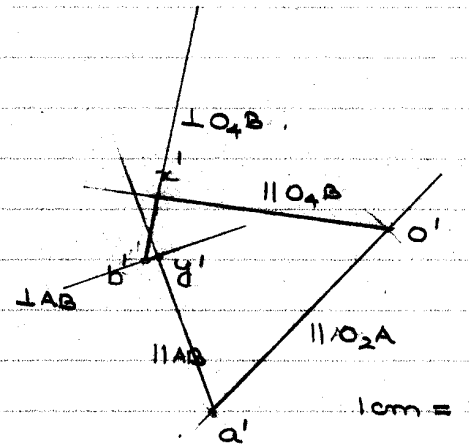
MECH 343/2 X: Theory of Machines I.
Solution to Assignment #6.

1.





1 cm = 250 m/s².

$O_2O_4 = 100$ mm
$O_2A = 350$ mm
$AB = 425$ mm
$O_4B = 400$ mm
1 cm = 100 mm.

$\omega_2 = 50$ rad/s = Const. (CW)
$\omega_3 = 36.80$ rad/s (CW)
$\omega_4 = 45.03$ rad/s. (CW)

$$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$$

$$\therefore (\vec{a}_B)_n + (\vec{a}_B)_t = \vec{a}_A + (a_{B/A})_n + (a_{B/A})_t$$

$$\vec{o'x'} + \vec{x'b'} = \vec{o'a'} + \vec{a'y'} + \vec{y'b'}$$

$\vec{x'b'}$: x' $\| O_4B$ o', $\perp O_4B$
$o'x' = 45.03^2 \times 0.4 = 811.1$ m/s²

$\vec{o'a'}$: o' $\| O_2A$ a', $o'a' = 50^2 \times 0.350 = 875$ m/s²

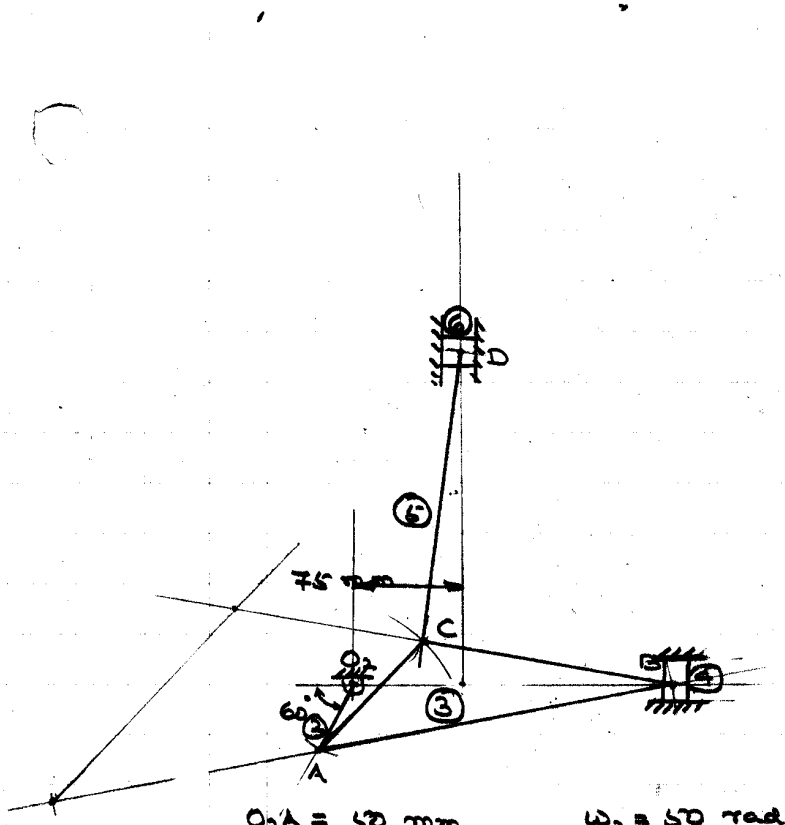
$\vec{a'y'}$: y' $\| AB$, $\perp AB$, a' y', $a'y' = 36.80^2 \times 0.425 = 575.6$ m/s²

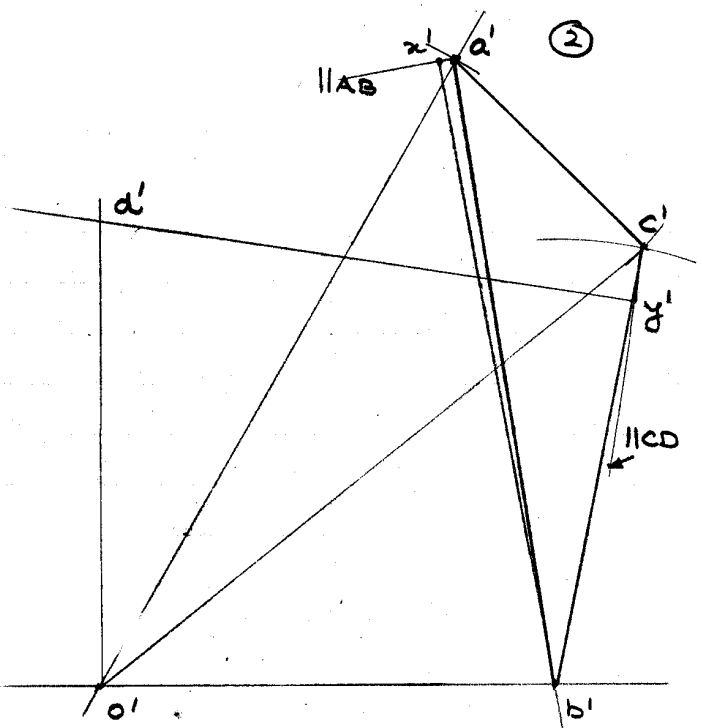
$\vec{a}_{B/A}$: A, α_3, B
$y'b' = 7.594$ m/s²

$\therefore \alpha_3 = \frac{7.594}{0.425} = 17.87$ rad/s² (CW)

$\vec{a}_B$: O_4, α_4, B
$x'b' = 186.2$ m/s²

$\therefore \alpha_4 = \frac{186.2}{0.4} = 465.5$ rad/s² (CW)





Acceleration Polygon
1 cm = 25 m/s².

O_2A = 50 mm
AB = 250 mm
BC = 175 mm
CA = 100 mm
CD = 200 mm
1 cm = 50 mm

ω_2 = 50 rad/s = Constant (CW)
ω_3 = 5.077 rad/s (CW)
ω_5 = 9.175 rad/s

$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$

$\vec{o'b'} = \vec{o'a'} + \vec{a'x'} + \vec{x'b'}$

(norm) (tang)

$\overline{\parallel O_2B}$.

a', $\parallel O_2A$, o'

$o'a' = 50^2 \times 0.1 = 250\ m/s^2$

x', a', $\parallel AB$, $\perp AB$

$a'x' = 5.077^2 \times 0.25 = 6.444\ m/s^2$

Also ABC are points on (3)

$\vec{a}_D = \vec{a}_C + \vec{a}_{D/C}$.

$\vec{o'd'} = \vec{o'c'} + \vec{c'y'} + \vec{y'd'}$

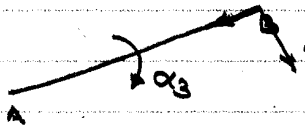
(norm) (tang)

Verf.. ✓

c', $\perp CD$, $\parallel CD$, y'

$c'y' = 9.175^2 \times 0.2 = 16.84\ m/s^2$

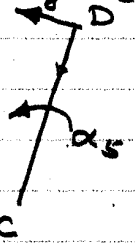
Link (3)



$a^t_{b'} = 218.7 \text{ m/s}^2$

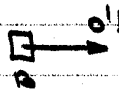
$\therefore \alpha_3 = \frac{218.7}{0.25} = 874.8 \text{ rad/s}^2$ CW.

Link (5)



$\alpha_5 = \frac{182.2}{0.2} = 911 \text{ rad/s}^2$ (CCW)

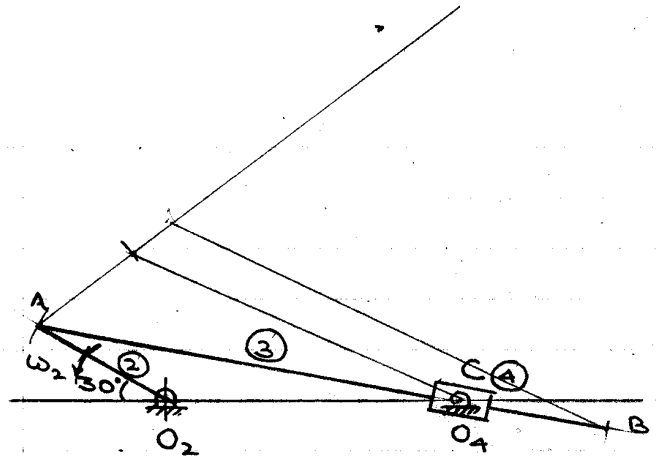
Slider B:



$a^t_{b'} = 158.8 \text{ m/s}^2$ (Right)

Slider D: $a^t_{d'} = 158.8 \text{ m/s}^2$ (up).

3.



$O_2A = 100$ mm

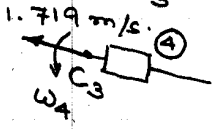
$O_2O_4 = 200$ mm

$AB = 400$ mm

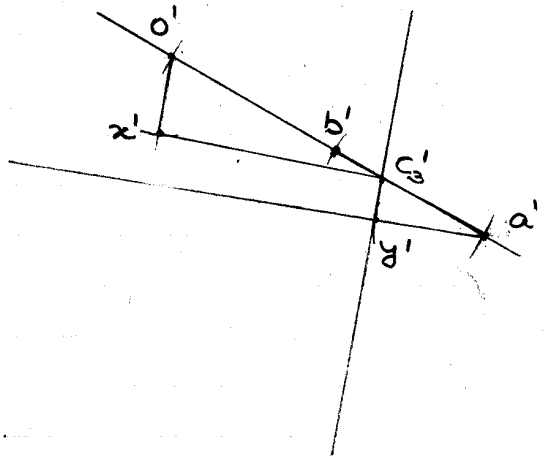
Scale: 1 cm = 50 mm

$\omega_2 = 50$ rad/s. (CCW)
= Const.

$\omega_3 = 16.14$ rad/s (CCW)



$\omega_4 = \omega_3$



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

$$\vec{a}_{C_3} + \vec{a}_{C_3|4} = \vec{a}_A + (\vec{a}_{C_3|A})_n + (\vec{a}_{C_3|A})_t$$

$\vec{a}_{C_3}$: o' → x', $\perp AB$

$\vec{a}_{C_3|4}$: $\parallel AB$

$\vec{a}_A$: o' → a', $\parallel O_2A$

$(\vec{a}_{C_3|A})_n$: y' → a', $\parallel AB$

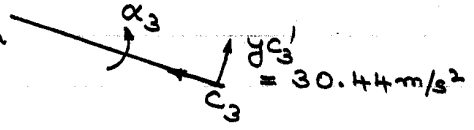
$(\vec{a}_{C_3|A})_t$: $\perp AB$

$o'x' = 2(16.14)(1.719)$
$= 55.49$ m/s²

$o'a' = 50^2 \times 0.1$
$= 250$ m/s²

$a'y' = 16.14^2 \times 0.2909$
$= 75.78$ m/s²

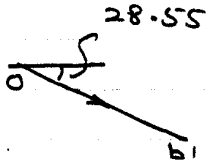
$a_{C_3|A}$:



$a_{C_3}' = 30.44$ m/s²

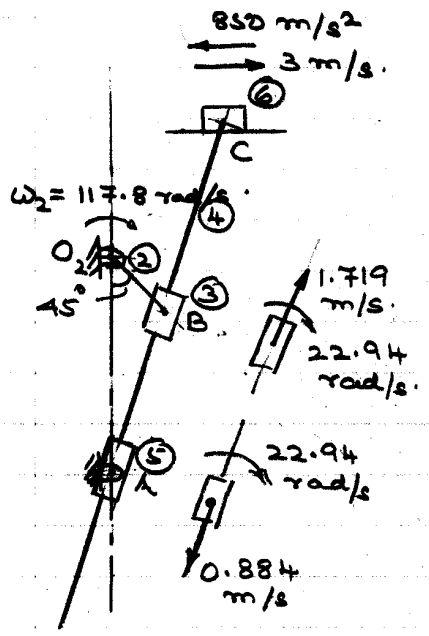
$$\alpha_3 = \frac{30.44}{0.2909} = 104.6 \text{ rad/s}^2 \text{ CCW}$$

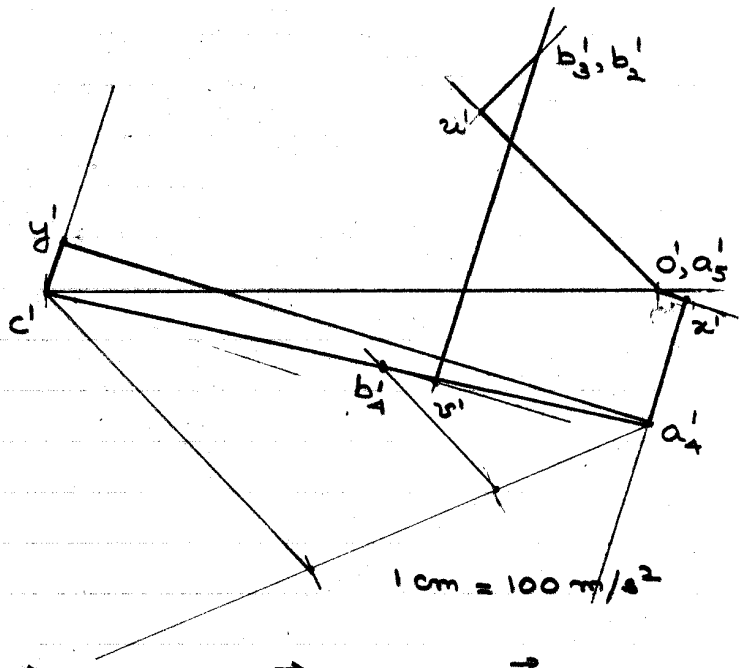
a_B:



$o'b' = 137.8$ m/s²

4.





$O_2A = 75$ mm

$AC = 125$ mm

$O_2B = 25$ mm

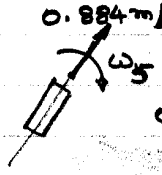
$AB \approx 60$ mm

1 cm = 25 mm.

1 cm = 100 m/s²

$\vec{a}_{A_4} = \vec{a}_C + \vec{a}_{A_4|C}$

$\vec{a}_{Cor} + \vec{a}_{A_4|5} = \vec{a}_C + (\vec{a}_{A_4|C})_n + (\vec{a}_{A_4|C})_t$



$o'x' \perp AC$ $\quad x' \parallel AC$ $\quad c' \leftarrow o'$ 850 m/s² $\quad y' \parallel AC$ $\quad \perp AC$

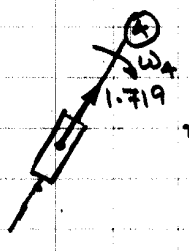
$o'x' = 2(0.884)(22.94)$
$= 40.56$ m/s².

$c'y' = 22.94^2 \times 0.125$
$= 65.78$ m/s²

A_4, B_4, C are on (4)
∴ Locate b'_4.

$\vec{a}_{B_3} = \vec{a}_{B_4} + \vec{a}_{B_3|B_4}$

$\therefore (\vec{a}_{B_3})_n + (\vec{a}_{B_3})_t = \vec{a}_{B_4} + \vec{a}_{Cor} + a_{B_3|4}$

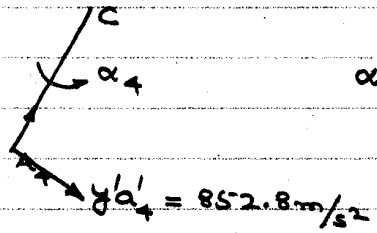


$u' \parallel O_2B$ $\quad O' \perp O_2B$ $\quad$ 45° $\quad$ (known) $b'_4 \perp AC$ $\quad v' \parallel AC$

$o'u' = 117.8^2 \times 0.025$
$= 346.92$ m/s²

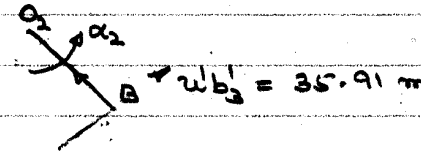
$b'_4v' = 2 \times 1.719 \times 22.94$
$= 78.87$ m/s².

α_4:



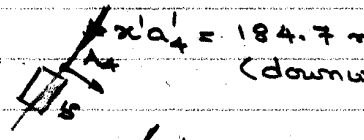
$$\alpha_4 = \frac{852.8}{0.125} = 6822.\ rad/s^2 \ (CCW)$$

α_2:



$$\alpha_2 = \frac{35.91}{0.025} = 1436\ rad/s^2 \ (CCW)$$

$\vec{a}_{A_4/5}$ =



$\vec{a}_{B_3/4}$ =