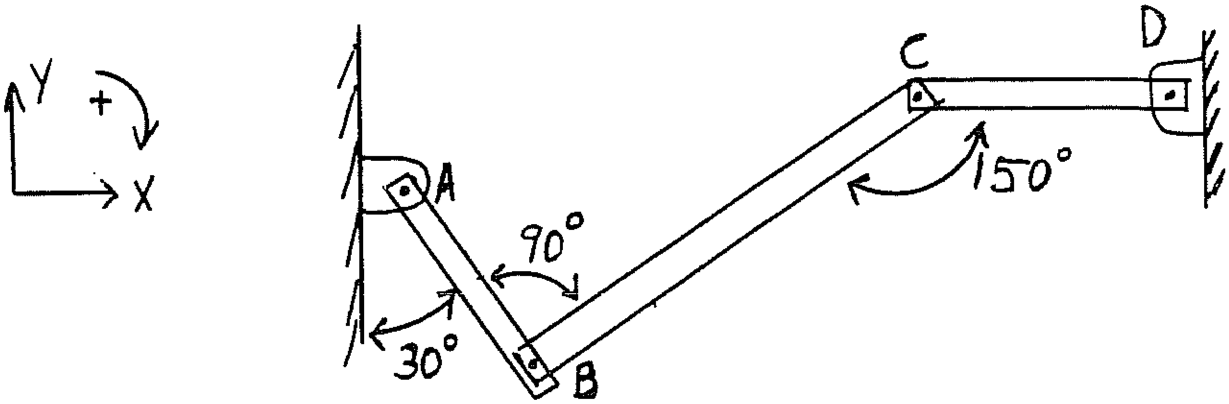
The three bars AB, BC, and CD are each pinned at their ends as shown. Bar AB has length 2 meters; bar BC has length 4 meters, and bar CD has length 3 meters. Bar AB has an angular velocity of $\omega_{AB} = +4\ s^{-1}$, and an angular acceleration of $\alpha_{AB} = -3\ s^{-2}$.

(a) Find the magnitude of acceleration, $|a_B|$, of point B.

(b) Find the angular velocity, ω_{BC}, of bar BC.

(c) Find the horizontal component of acceleration of point C.



(From April '98 exam)

(a) $\vec{a}_B = \vec{a}_A^{\,0} + (\vec{a}_{B/A})_n + (\vec{a}_{B/A})_t$

$a_n = \omega^2 r_{AB} = V_B^2 / r_{AB} = \frac{8^2}{2} = 32\ m/s^2.$

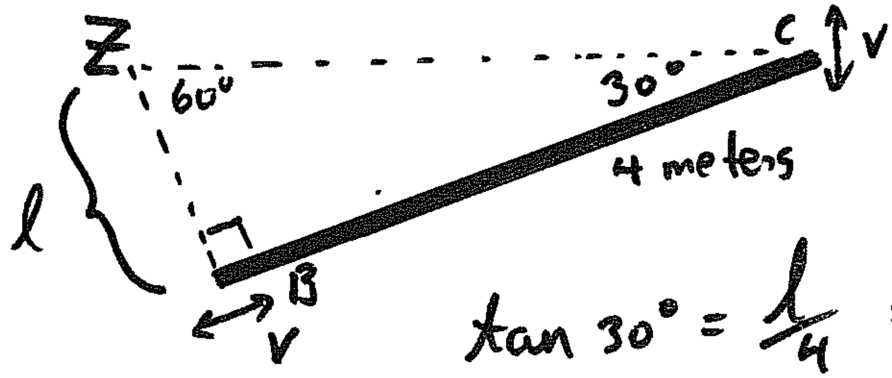
$a_t = \alpha r_{AB} = (3)(2) = 6\ m/s^2$

But a_n & a_t are perpendicular to each other

$\Rightarrow |\vec{a}| = \sqrt{a_n^2 + a_t^2}$

$= \sqrt{32^2 + 6^2} = 32.56\ m/s^2$

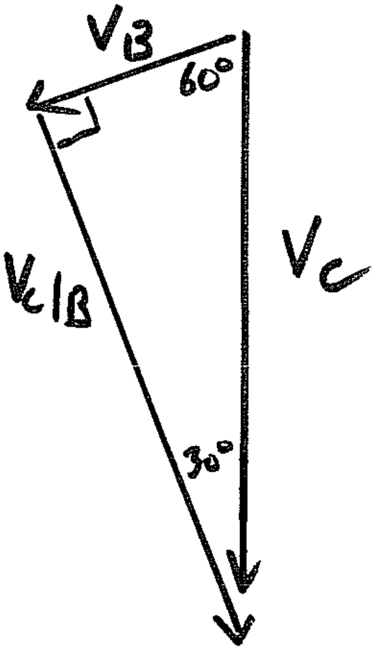
(b) center of zero velocity of BC is at "Z"



$$\tan 30° = \frac{l}{4} \Rightarrow l = 2.31 \text{ meters}$$

$$V_B = \omega_{BC}\, l \Rightarrow \omega_{BC} = \frac{V_B}{l} = \frac{8}{2.31} = 3.464\ s^{-1}$$

or draw a vector triangle: $\vec{V}_C = \vec{V}_B + \vec{V}_{C/B}$



(c)

$$V_{C/B} = \omega_{BC}\, r_{BC}$$
$$= (3.464)(4) = 13.856$$

& $V_B = 8$ m/s.

By pythagoras,

$$V_C = \sqrt{13.856^2 + 8^2} = 16 \text{ m/s}.$$

$$\Rightarrow (a_C)_{horizontal} = \frac{V_C^2}{r_{CD}} = \frac{16^2}{3} = 85.3 \text{ m/s}^2$$