Exercise Sheet 2

Q1. $V_A = \omega . OA = 5 \times 1.5 = 7.5\ m/s$ $\quad V_B = \omega . OB = 5 \times 2.2 = 11\ m/s$

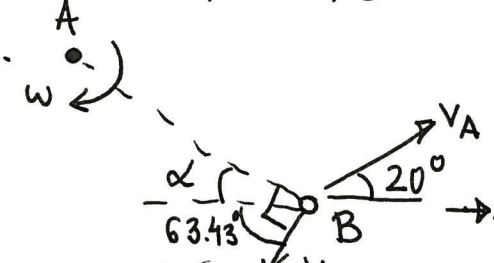
$a_A^n = \omega^2 . OA = 5^2 \times 1.5 = 37.5\ m/s^2$ $\quad a_B^n = \omega^2 . OB = 5^2 \times 2.2 = 55\ m/s^2$

$a_A^t = \alpha . OA = 2 \times 1.5 = 3\ m/s^2$ $\quad a_B^t = \alpha . OB = 2 \times 2.2 = 4.4\ m/s^2$

$a_A = \sqrt{(a_A^n)^2 + (a_A^t)^2} = \sqrt{37.5^2 + 3^2} = 37.62\ m/s^2$

$a_B = \sqrt{(a_B^n)^2 + (a_B^t)^2} = \sqrt{55^2 + 4.4^2} = 55.18\ m/s^2$

Q2.



$\alpha = \tan^{-1}\left(\frac{0.1}{0.2}\right)$

$\alpha = 26.57°$

$\underline{V}_B = \underline{V}_A + \underline{V}_{BA}$

$V_{BA} = \omega . BA = 8\sqrt{0.1^2 + 0.2^2} = 1.789\ m/s$

$\rightarrow + \sum H$: $V_{Bh} = V_A \cos 20° - V_{BA} \cos 63.43°$

$= 2\cos 20° - 1.789 \cos 63.43° = 1.079\ m/s$

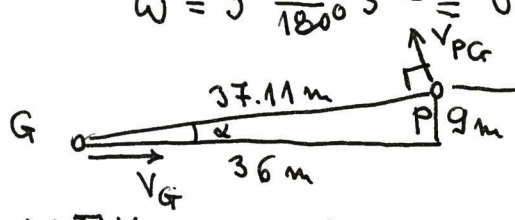
$\uparrow + \sum V$: $V_{BV} = V_A \sin 20° - V_{BA} \sin 63.43°$

$= 2 \sin 20° - 1.789 \sin 63.43° = 0.9160\ \frac{m}{s}$

$V_B = \sqrt{V_{Bh}^2 + V_{BV}^2} = \sqrt{1.079^2 + 0.916^2} = 1.415\ m/s$

Q3. $150\ knots \times 0.5144 = 77.16\ m/s = V_G$

$\omega = 5° \frac{\pi}{180°}\ s^{-1} = 0.08727\ rad/s$



$\alpha = \tan^{-1}\left(\frac{9}{36}\right) = 14.04°$

$\underline{V}_P = \underline{V}_G + \underline{V}_{PG}$

$V_{PG} = \omega . PG = 0.08727 \times 37.11 = 3.239\ m/s$

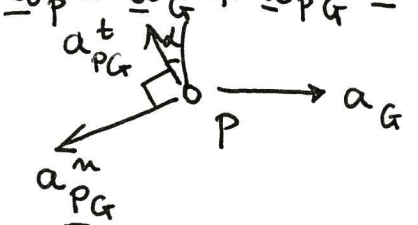
$\rightarrow + \sum X$: $V_{Px} = V_G - V_{PG} \sin 14.04° = 77.16 - 3.239 \sin 14.04° = 76.37\ m/s$

$\uparrow + \sum Y$: $V_{Py} = 0 + V_{PG} \cos 14.04° = 3.239 \cos 14.04° = 3.142\ m/s$

$V_P = \sqrt{V_{Px}^2 + V_{Py}^2} = \sqrt{76.37^2 + 3.142^2} = 76.43\ m/s$

$\alpha = 10° \frac{\pi}{180°}\ s^{-2} = 0.1745\ rad/s^2$ $\quad a_G = 3\ m/s^2$

$\underline{a}_P = \underline{a}_G + \underline{a}_{PG} = \underline{a}_G + \underline{a}_{PG}^n + \underline{a}_{PG}^t$



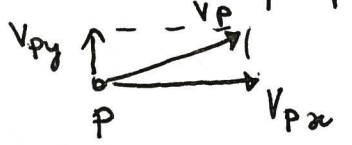
$a_{PG}^n = \omega^2 . PG = 0.08727^2 \times 37.11 = 0.2826\ \frac{m}{s^2}$

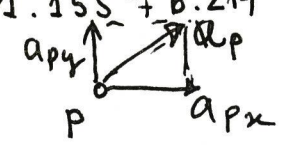
$a_{PG}^t = \alpha . PG = 0.1745 \times 37.11 = 6.476\ \frac{m}{s^2}$

$\rightarrow + \sum X$: $a_{Px} = a_G - a_{PG}^n \cos 14.04° - a_{PG}^t \sin 14.04° = 1.155\ m/s^2$

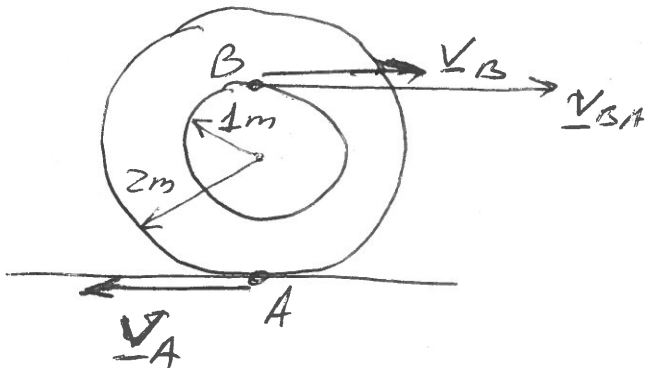
$\uparrow + \sum Y$: $a_{Py} = 0 - a_{PG}^n \sin 14.04° + a_{PG}^t \cos 14.04° = 6.214\ m/s^2$

$a_P = \sqrt{a_{Px}^2 + a_{Py}^2} = \sqrt{1.155^2 + 6.214^2} = 6.320\ m/s^2$





Q4



$V_A = 1 \ m/s$

$V_B = 3 \ m/s$

$\omega = ?$

$\underline{V}_B = \underline{V}_A + \underline{V}_{BA}$

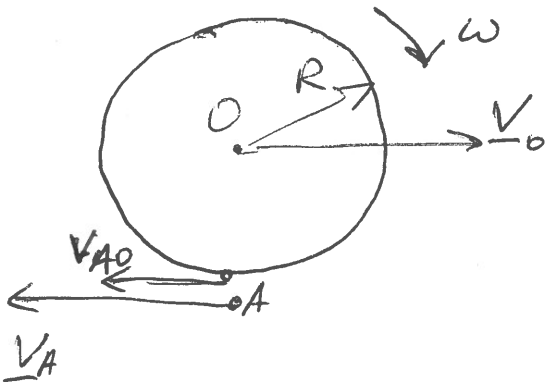
$\rightarrow^+ : \ V_B = -V_A + V_{BA}$

$V_{BA} = \omega AB$

$V_B + V_A = \omega AB$

$\omega = \frac{V_A + V_B}{AB} = 4/3 \ rad/s$

Q5



$V_o = 5 \ m/s$

$\omega = 3 \ rad/s$ $\qquad V_A = ?$

$R = 0.6 \ m$

$\underline{V}_A = \underline{V}_o + \underline{V}_{AO}$

$V_{AO} = \omega AO$

$\rightarrow^+ : \ -V_A = V_o - V_{AO}$

$V_A = V_{AO} - V_o =$

$= \omega AO - V_o =$

$= 3 \times 0.6 - 5 = -3.2 \ m/s$