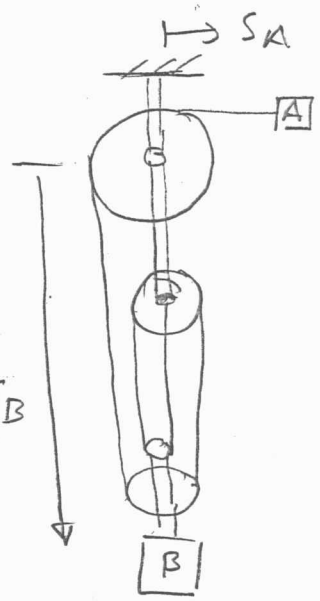
HW4

spring 2010

12-175



$4s_B + s_A = 0 \rightarrow 4v_B = -v_A$

$4a_B + a_A = 0 \rightarrow a_B = -\frac{a_A}{4} = -0.05\ m/s^2$

$\downarrow\ v_B = v_{B_0} + a_B t$

$-8\ m/s = 0 - 0.05t \rightarrow t = \frac{8}{0.05}$

$\hookrightarrow t = 160\ s$

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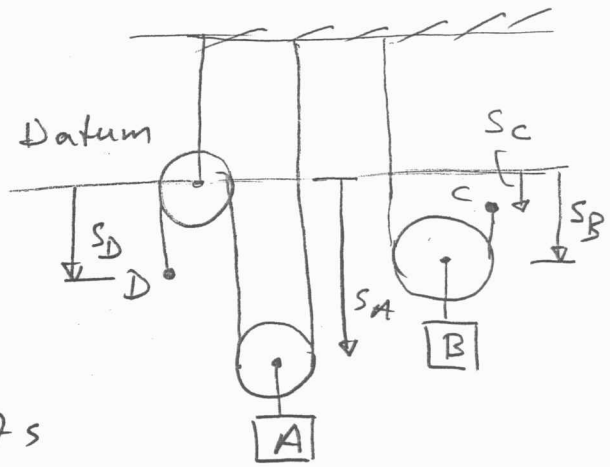

a) $a_D = 8\ m/s^2$

$\hookrightarrow v_D = 8t \qquad s_D = 4t^2$

$s_D + 2s_A = l_1$

$\hookrightarrow \Delta s_D = -2\Delta s_A$

$\hookrightarrow \Delta s_A = -\frac{\Delta s_D}{2} = -2t^2$

$-3 = -2t^2 \rightarrow t = 1.2247\ s$

b) $v_A = \dot{s}_A = -4t = -4(1.2247) = -4.9\ m/s$

$s_B + (s_B - s_C) = l_2$

$\hookrightarrow 2v_B = v_C = -4\ m/s$

$\hookrightarrow v_B = -2\ m/s = 2\ m/s\ \uparrow$

$\downarrow: v_A = v_B + v_{A/B}$

$-4.9 = -2 + v_{A/B}$

$\hookrightarrow v_{A/B} = -2.9\ m/s = 2.9\ m/s\ \uparrow$

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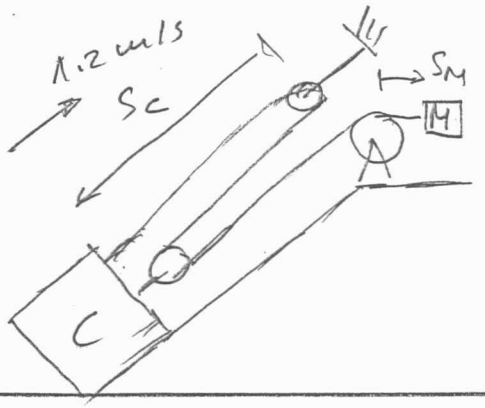
$s_M + 3s_C = \ell$

$\rightarrow v_M = -3v_C$

$= -3(-1.2)\ m/s$

$v_M = 3.6\ m/s$



12-205

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

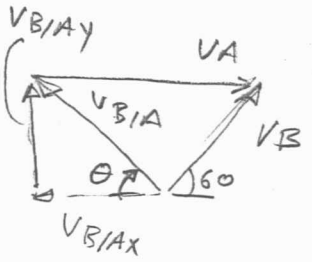
$15\cos60\,\vec{i} + 15\sin60\,\vec{j} = 30\,\vec{i} + v_{B/A,x}\,\vec{i} + v_{B/A,y}\,\vec{j}$

$\hookrightarrow v_{B/Ax} = 15\cos60 - 30 = -22.5\ m/s$

$v_{B/Ay} = 15\sin60 = 12.99\ m/s$

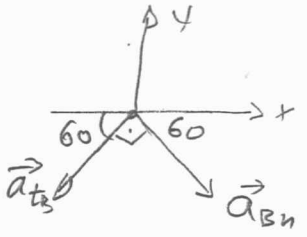
$v_{B/A} = \sqrt{v_{B/Ax}^2 + v_{B/A,y}^2} = 26\ m/s$

$\theta = \tan^{-1}\frac{v_{B/A,y}}{v_{B,A,x}} = 30^\circ$



$a_{Bt} = -0.8\ m/s$

$a_{Bn} = v_B^2/\rho = 15^2/250 = 0.9\ m/s^2$



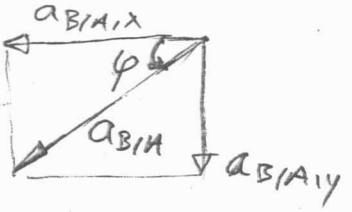
$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$

$-0.8(\cos60\,\vec{i} + \sin60\,\vec{j}) + 0.9(\sin60\,\vec{i} - \cos60\,\vec{j}) = 2\vec{i} + \vec{a}_{B/A}$

$\hookrightarrow \vec{a}_{B/A} = -1.6206\,\vec{i} - 1.1428\,\vec{j}$

$a_{B/A} = \sqrt{(-1.6206)^2 + (-1.1428)^2}$

$= 1.98\ m/s^2$



$\varphi = \tan^{-1}\frac{1.1428}{1.6206} = 35.2$

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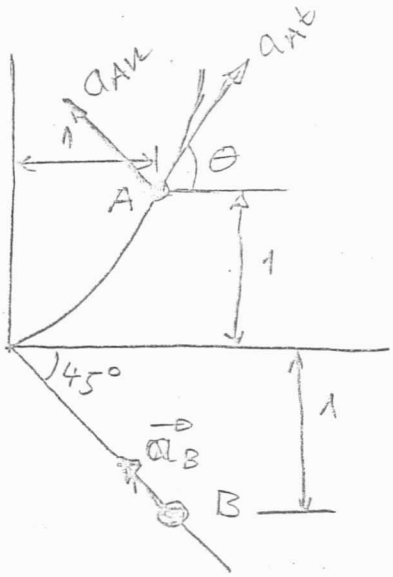
$\therefore v_A = v_B = 8\ m/s \quad , a_B = 6\ m/s^2$



$\vec{a}_B = 6(-\cos 45\,\vec{i} + \sin 45\,\vec{j})$

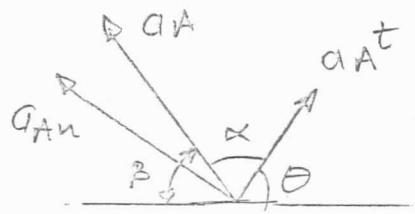
$\vec{a}_B = \frac{6}{\sqrt{2}}(-\vec{i} + \vec{j})$

$a_t = 5\ m/s^2$

$a_n = \frac{v^2}{\rho}$

$y = x^{3/2} \qquad \frac{dy}{dx} = \frac{3}{2}x^{1/2}$

$\frac{d^2y}{dx} = \frac{3}{2}\frac{1}{2}\frac{1}{\sqrt{x}}$



$\tan\theta = \left.\frac{dy}{dx}\right|_{x=1,y=1} = \frac{3}{2} \Rightarrow \theta = 56.31°$

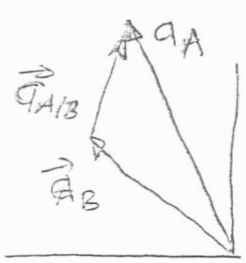
$\rho = \left|\frac{[1+(dy/dx)^2]^{3/2}}{d^2y/dx^2}\right|_{\substack{x=1\\y=1}} = \frac{[1+(\frac{3}{2})^2]^{3/2}}{3/4} = 7.812\ m$

$\hookrightarrow a_{An} = \frac{8^2}{7.812} = 8.192\ m/s^2 \Rightarrow a_A = \sqrt{a_{An}^2 + a_{At}^2} = 9.6\ m/s^2$

$\tan\alpha = a_{An}/a_{At} \Rightarrow \alpha = 58.6 \Rightarrow \beta = 65.1$

$\hookrightarrow \vec{a}_A = 9.6(-\cos 65.1\,\vec{i} + \sin 65.1\,\vec{j})$

$= -4.04\vec{i} + 8.71\vec{j}$



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

$\hookrightarrow \vec{a}_{A/B} = \vec{a}_A - \vec{a}_B = -4.04\vec{i} + 8.71\vec{j} - \frac{6}{\sqrt{2}}(-\vec{i} + \vec{j})$

$= 0.203\vec{i} + 4.467\vec{j}$

$a_{A/B} = \sqrt{20} = 4.472\ m/s^2$