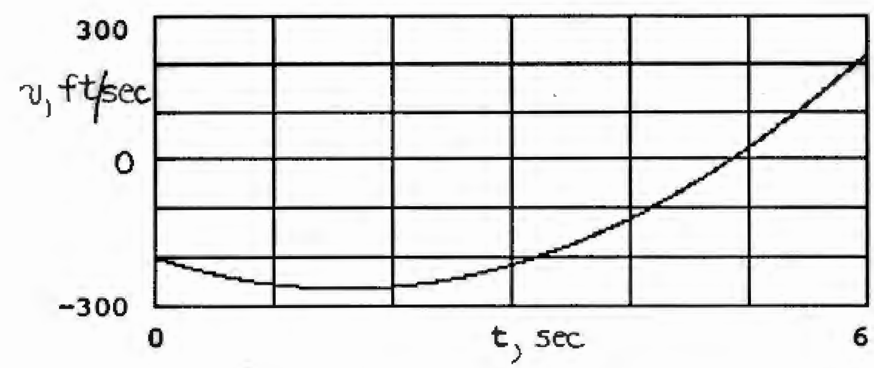
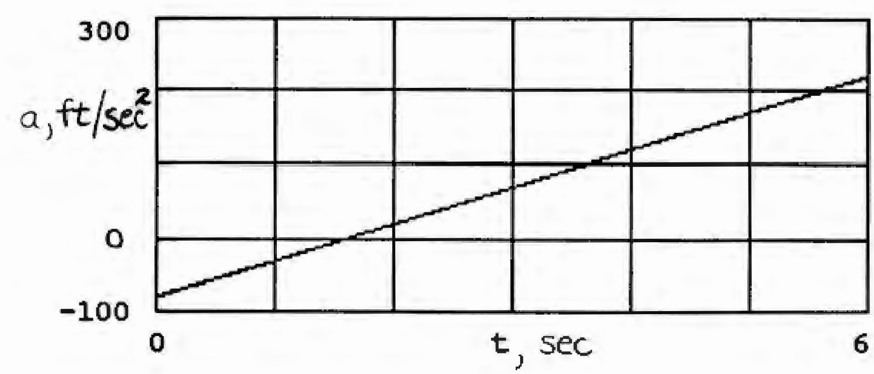
2/1

$$v = 25t^2 - 80t - 200$$
$$a = \frac{dv}{dt} = 50t - 80$$
See plots

$a = 0$: $50t - 80 = 0$, $t = 1.6$ sec

At $t = 1.6$ sec, $v = 25(1.6)^2 - 80(1.6) - 200 = \underline{-264 \ \frac{ft}{sec}}$





2/96 With x-y coordinates, origin at A: $\overset{|y}{A\!\cdot\!--x}$

$x = x_0 + v_{x_0} t$ @ B: $\quad 360 = 0 + (100\cos\alpha)t_f \quad (1)$

$y = y_0 + v_{y_0} t - \frac{1}{2}gt^2$ @ B: $\quad -80 = 0 + (100\sin\alpha)t_f - \frac{1}{2}(32.2)t_f^2 \quad (2)$

Simultaneous solutions of (1) & (2):

$$\begin{cases} t_f = 4.03 \text{ sec}, & \alpha = 26.8° \quad (a) \\ t_f = 5.68 \text{ sec}, & \alpha = 50.7° \quad (b) \end{cases}$$

Check at corner $[(x, y) = (280', 0)]$:

(a) $t_c = \dfrac{280}{100\cos 26.8°} = 3.14$ sec

$y_c = 100\sin 26.8°(3.14) - \dfrac{32.2}{2}(3.14)^2 = -16.94$ ft

So conditions (a) are not possible.

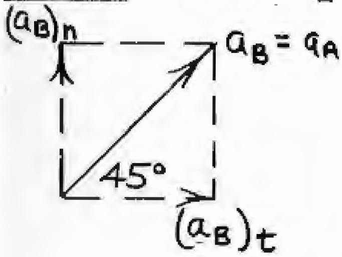
(b) $t_c = \dfrac{280}{100\cos 50.7°} = 4.42$ sec

$y_c = 100\sin 50.7°(4.42) - \dfrac{32.2}{2}(4.42)^2 = 27.5$ ft

Conditions (b) result in clearance at corner

Ans. $\underline{\alpha = 50.7°}$

2/194 With $\underline{a}_{B/A} = \underline{0}$, $\underline{a}_A = \underline{a}_B$



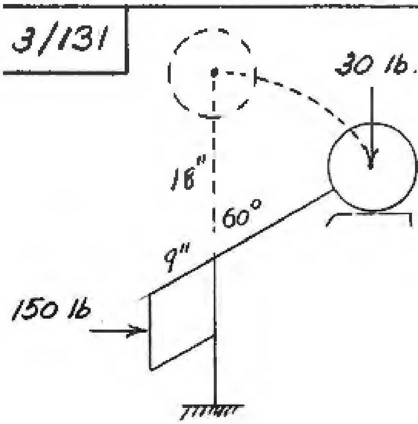
$$(a_B)_n = \frac{v_B^2}{\rho} = \frac{\left(45\,\frac{44}{30}\right)^2}{600}$$

$$= 7.26 \text{ ft/sec}^2$$

$$\dot{v}_B = (a_B)_t = \underline{7.26 \text{ ft/sec}^2}$$

$$a_A = a_B = 7.26\sqrt{2} = \underline{10.27 \frac{\text{ft}}{\text{sec}^2}}$$

3/131



$U_{1-2} = \Delta T$

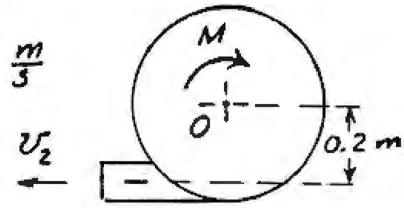
$150\left(\frac{9}{12}\sin 60^\circ\right) - 30\frac{18}{12}(1-\cos 60^\circ)$

$= \frac{1}{2}\frac{30}{32.2}(v^2 - 0^2)$

$v^2 = 160.8$, $\underline{v = 12.68 \text{ ft/sec}}$

4/56 $M = M_O = m'(v_2 d_2 - 0)$

$v_2 = \frac{Q}{A} = \frac{16}{\pi(0.150)^2/4}\,\frac{1}{60} = 15.09\ \frac{m}{s}$



From Table D-1, air density is 1.206 kg/m^3

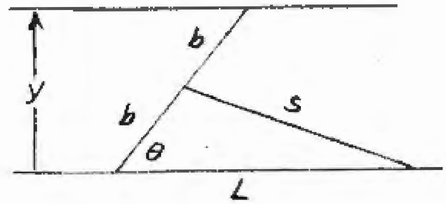
so $m' = \rho Q = 1.206(16)/60 = 0.322\ kg/s$

$M_O = 0.322(15.09 \times 0.2 - 0) = 0.971\ N\cdot m$

$P = 0.32 + M_O\omega/1000 = 0.32 + \frac{0.971(3450 \times 2\pi/60)}{1000}$

$P = 0.32 + 0.351 = \underline{0.671\ kW}$

5/44



$y = 2b\sin\theta$

$v = \dot{y} = 2b\dot{\theta}\cos\theta$

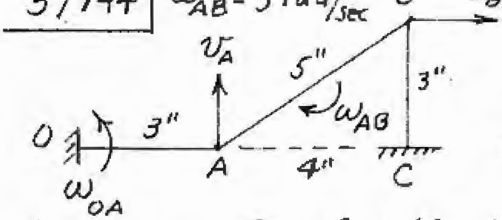
$s^2 = b^2 + L^2 - 2bL\cos\theta$

$2s\dot{s} = 0 + 0 + 2bL\dot{\theta}\sin\theta$

$\dot{\theta} = \dfrac{s\dot{s}}{bL\sin\theta}$

So $v = 2b\dfrac{s\dot{s}}{bL\sin\theta}\cos\theta = 2\dfrac{\sqrt{b^2+L^2-2bL\cos\theta}}{L\tan\theta}\dot{s}$

5/144 $\omega_{AB} = 3$ rad/sec



C = instant. center of AB

$\omega_{AB} = \dfrac{v_A}{\overline{AC}}$, $v_A = \dfrac{4}{12}3 = 1$ ft/sec

$v_B = \overline{BC}\,\omega_{AB} = \dfrac{3}{12}3 = 0.75$ ft/sec

$(\alpha_{OA} = 0)$ $\quad \underline{a}_B = \underline{a}_A + (\underline{a}_{B/A})_n + (\underline{a}_{B/A})_t$

$(a_B)_n = v_B^2/\overline{BC} = (0.75)^2/\frac{3}{12} = 2.25$ ft/sec^2

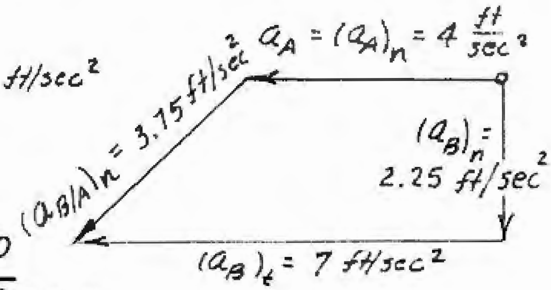
$(a_B)_t = \overline{BC}\,\alpha_{BC}$

$(a_{B/A})_n = \overline{AB}\,\omega_{AB}^2 = \frac{5}{12}3^2 = 3.75$ ft/sec^2

$(a_{B/A})_t = \overline{AB}\,\alpha_{AB}$

$(a_A)_n = v_A^2/\overline{AO} = 1^2/\frac{3}{12} = 4$ ft/sec^2

$(a_A)_t = \overline{AO}\,\alpha_{AO} = 0$

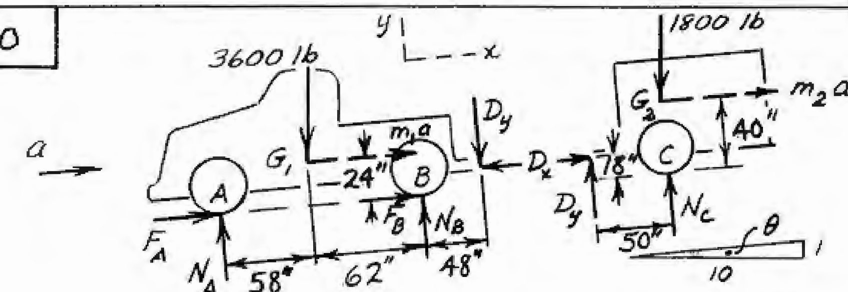


From diag,

$(a_{B/A})_t = 0$ so $\underline{\alpha_{AB} = \alpha_{ABD} = 0}$

$\alpha_{BC} = 7/\frac{3}{12} = \underline{28 \text{ rad/sec}^2 \text{ CCW}}$

6/30



For const. accel., $\theta = \tan^{-1}\frac{1}{10} = 5.71°$

$v^2 = v_0^2 + 2as$: $44^2 = 88^2 - 2a(360)$, $a = 8.07$ ft/sec² decel.

$m_1 a = \frac{3600}{32.2} \times 8.07 = 902$ lb, $m_2 a = \frac{1800}{32.2} \times 8.07 = 451$ lb

Trailer: $\Sigma F_x = ma_x$: $D_x - 1800 \sin 5.71° = 451$, $\underline{D_x = 630 \text{ lb}}$

$\Sigma M_C = mad$: $50 D_y + 630(18) - 1800 \sin 5.71°(40) = 451(40)$, $\underline{D_y = 277 \text{ lb}}$

$\Sigma F_y = 0$: $N_C - 1800 \cos 5.71° + 277 = 0$, $\underline{N_C = 1514 \text{ lb}}$

Truck:

$\Sigma M_A = mad$: $3600 \cos 5.71° \times 58 - 3600 \sin 5.71° \times 24 - 120 N_B$

$+ 277(168) - 630(18) = 902(24)$

$\underline{N_B = 1773 \text{ lb}}$

7/88

Eq. 7/23 $\Sigma M_x = 0 + I_{yz}\,\omega_z^2$

From sol. to Prob. 7/87

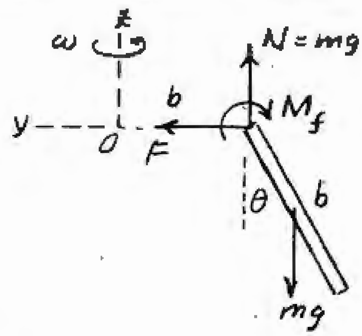
$I_{yz} = \frac{mb^2}{4}\left(\frac{2}{3}\sin 2\theta + \cos\theta\right)$

$M_f + mg\left(\frac{b}{2} + \frac{b}{2}\sin\theta\right) - mg\frac{b}{2}$

$= \frac{mb^2}{4}\left(\frac{2}{3}\sin 2\theta + \cos\theta\right)\omega^2$

$M_f = \frac{mb}{2}\left\{\cos\theta\left[\frac{2}{3}\sin\theta + \frac{1}{2}\right]b\omega^2 - g\sin\theta\right\}$

where $\omega^2 > \frac{6g\tan\theta}{b(4\sin\theta + 3)}$



8/42 $x = (A_1 + A_2 t)e^{-\omega_n t}$

$x(t=0) = A_1 = x_0$

$\dot{x} = A_2 e^{-\omega_n t} - \omega_n (A_1 + A_2 t) e^{-\omega_n t}$

$\dot{x}(t=0) = A_2 - \omega_n A_1 = \dot{x}_0$

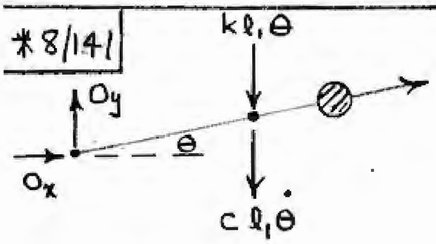
$A_2 = \dot{x}_0 + \omega_n x_0$

So $x = [x_0 + (\dot{x}_0 + \omega_n x_0)t] e^{-\omega_n t}$

For x to become negative with $x_0 > 0$,

$\dot{x}_0 + \omega_n x_0 < 0$, $\dot{x}_0 < -\omega_n x_0$ or $\underline{(\dot{x}_0)_c = -\omega_n x_0}$

*8/141



Eq. 4/13 : (with $\bar{\rho} = 0$)

$$\Sigma \underline{M}_o = \dot{\underline{H}}_{o_r} + \underline{\bar{\rho}} \times m\underline{a}_o$$

For small θ,

$$-kl_1^2\theta - cl_1^2\dot{\theta} = ml_2^2\ddot{\theta} + ml_2\ddot{y}_B$$

or $$\ddot{\theta} + \frac{cl_1^2}{ml_2^2}\dot{\theta} + \frac{kl_1^2}{ml_2^2}\theta = \frac{b}{l_2}\omega^2 \sin \omega t$$

Steady-state amplitude :

$$\Theta = Mb\left(\frac{\omega}{\omega_n}\right)^2 \frac{1}{l_2}, \text{ where } M = \text{magnification factor}$$

$$\text{Pen amplitude} = l_3\Theta = Mb\left(\frac{\omega}{\omega_n}\right)^2 \frac{l_3}{l_2} = A$$

Set up computer program to determine range of k for which $A \leq 1.5b$. Note that $\omega_n = \frac{l_1}{l_2}\sqrt{\frac{k}{m}}$, $2\zeta\omega_n = \frac{cl_1^2}{ml_2^2}$ or

$\zeta = \frac{cl_1}{2l_2}\sqrt{\frac{1}{km}}$. Answer: $0 < k < 1.895 \frac{lb}{ft}$