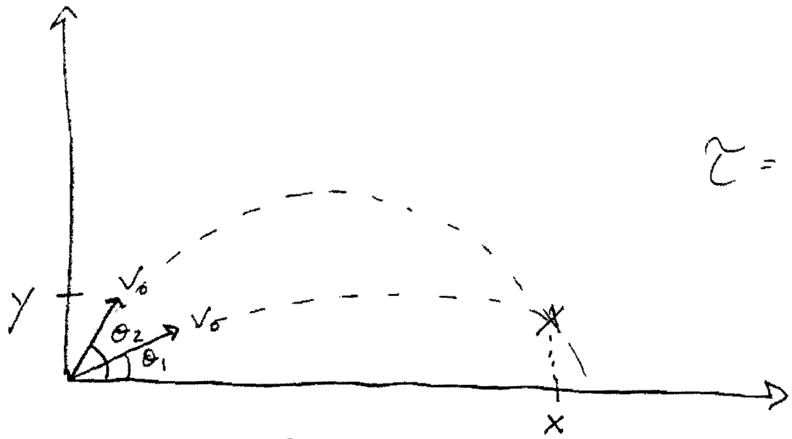
Dis 6A 2.1

1.33)



$\tau = ?$

$$y = V_0 \sin\theta_2 \, t_2 - \frac{1}{2} g t_2^2$$

$$x = V_0 \cos\theta_2 \, t_2$$

$$y = V_0 \sin\theta_1 \, t_1 - \frac{1}{2} g t_1^2$$

$$x = V_0 \cos\theta_1 \, t_1$$

$t_2 = t_1 + \tau$

condition of firing

$$t_2 \cos\theta_2 = t_1 \cos\theta_1$$

$$\sin\theta_2 t_2 - \frac{g}{2V_0} t_2^2 = \sin\theta_1 t_1 - \frac{g}{2V_0} t_1^2$$

$$t_2 = t_1 + \tau$$

$$\sin\theta_2 \, t_1 \frac{\cos\theta_1}{\cos\theta_2} - \frac{g}{2V_0}\left(\frac{t_1 \cos\theta_1}{\cos\theta_2}\right)^2 = \sin\theta_1 \, t_1 - \frac{g}{2V_0} t_1^2$$

$$t_2 = t_1 + \tau = \frac{t_1 \cos\theta_1}{\cos\theta_2}$$

$$\frac{\sin\theta_2 \cos\theta_1 - \sin\theta_1 \cos\theta_2}{\cancel{\cos\theta_2}} = \left(\frac{g}{2V_0}\right)\left(\frac{\cos^2\theta_1 - \cos^2\theta_2}{\cos^2\theta_2}\right) t_1$$

$$t_1 = \frac{\tau}{\frac{\cos\theta_1}{\cos\theta_2} - 1}$$

1.33) Dis 6A 2.2

$$\tau = \frac{2V_0}{g} \frac{(\sin\theta_2\cos\theta_1 - \sin\theta_1\cos\theta_2)\cancel{\cos\theta_2}}{\cos^2\theta_1 - \cos^2\theta_2} \left(\frac{\cos\theta_1 - \cos\theta_2}{\cancel{\cos\theta_2}}\right)$$

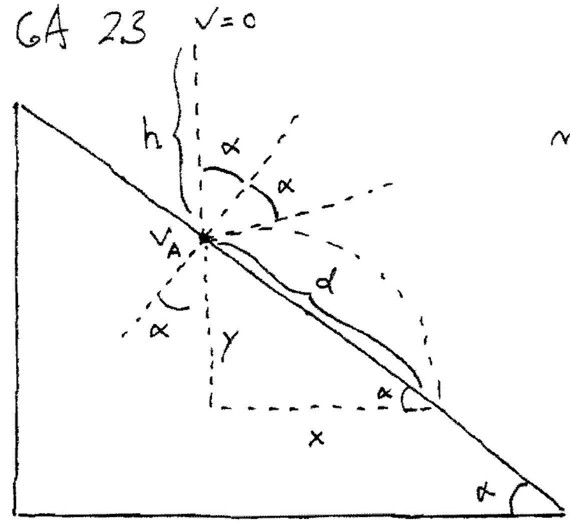
$$\boxed{\tau = \frac{2V_0}{g} \frac{\sin\theta_2\cos\theta_1 - \sin\theta_1\cos\theta_2}{\cos\theta_1 + \cos\theta_2}}$$

note: if $\theta_1 = \theta_2$ no collision occures

using $\sin(\theta_2 - \theta_1) = \sin\theta_2\cos\theta_1 - \sin\theta_1\cos\theta_2$

$$\boxed{\tau = \left(\frac{2V_0}{g}\right) \frac{\sin(\theta_2 - \theta_1)}{\cos\theta_1 + \cos\theta_2}} \simeq 1/s$$

1.31) Dis GA 23



$$mgh = \frac{1}{2} m v_A^2 \qquad d = ?$$

$$d = \sqrt{x^2 + y^2}$$

$$y/x = \tan\alpha$$

$$-y = V_A \cos(2\alpha) t - \frac{1}{2} g t^2$$

$$x = V_A \sin(2\alpha) t$$

$$d = \frac{x}{\cos\alpha} \qquad -\cancel{x}\tan\alpha = \frac{\cos(2\alpha)}{\sin(2\alpha)}\cancel{x} - \frac{1}{2} g \frac{x^{\cancel{2}}}{V_A^2 \sin^2(2\alpha)}$$

$\sin(2\alpha) = 2\cos\alpha\sin\alpha$

$\cos(2\alpha) = \cos^2\alpha - \sin^2\alpha$

$$\frac{xg}{2V_A^2} = \cos(2\alpha)\sin(2\alpha) + \frac{\sin\alpha}{\cos\alpha}\sin^2(2\alpha)$$

$$x = \left(\frac{V_A^2}{g}\right)\left[2\cos(2\alpha)\sin(2\alpha) + 8\frac{\sin^3\alpha\cos^2\alpha}{\cos\alpha}\right]$$

$$= \left(\frac{V_A^2}{g}\right)\left[4\left(\cos^3\alpha\sin\alpha - \sin^3\alpha\cos\alpha\right) + 8\sin^3\alpha\cos\alpha\right]$$

$$= 4\,(2h)\sin\alpha\cos\alpha$$

$$\Rightarrow \boxed{d = 8h\sin\alpha}$$