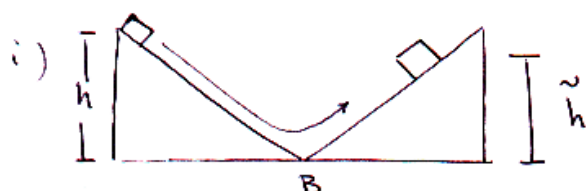
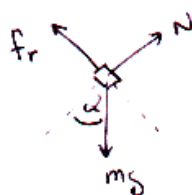


SOLUCIÓN CONTROL 2

P2



DCL



$$-f_r + mg \sin \alpha = ma$$

$$N - mg \cos \alpha = 0$$

$$\Rightarrow N = mg \cos \alpha$$

$$a = g \sin \alpha \left(1 - \frac{\mu}{\tan \alpha}\right)$$

DESDE EL PUNTO h HASTA LA BASE DEL PLANO INCLINADO

$$\left. \begin{aligned} E_i &= mgh \\ E_B &= \frac{1}{2} m v_B^2 \end{aligned} \right\}$$

$$\Delta E = \frac{1}{2} m v_B^2 - mgh = W_{roce}$$

$$\frac{1}{2} m v_B^2 - mgh = -\mu mg \cos \alpha \frac{h}{\sin \alpha}$$

$$\frac{1}{2} m v_B^2 = mgh \left(1 - \frac{\mu}{\tan \alpha}\right)$$

DESDE LA BASE HASTA EL PUNTO $\tilde{h}$

$$E_i = E_B = \frac{1}{2} m v_B^2$$

$$E_f = mg \tilde{h}$$

SOLUCIÓN CONTROL 2

$$\Delta E = W_{roce} \Rightarrow m g \tilde{h} - \frac{1}{2} m v_B^2 = -\mu m g \frac{\tilde{h}}{\tan \alpha}$$

$$\frac{1}{2} m v_B^2 = m g \tilde{h} \left(1 + \frac{\mu}{\tan \alpha} \right)$$

POR LO TANTO

$$m g h \left(1 - \frac{\mu}{\tan \alpha} \right) = m g \tilde{h} \left(1 + \frac{\mu}{\tan \alpha} \right)$$

$$\tilde{h} = h \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)$$

DESPUÉS DE UN CICLO

$$h_1 = \tilde{h} \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right) = h \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^2$$

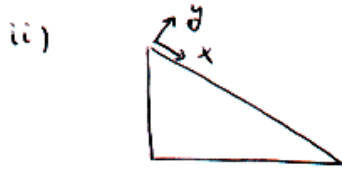
PARA EL CICLO n

$$h_{n+1} = h_n \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^2$$

$$\Rightarrow \boxed{h_n = h \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^{2n}}$$

$$\therefore \Delta h = h_{n+1} - h_n = h_n \left[\left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^2 - 1 \right]$$

SOLUCIÓN CONTROL 2



TIEMPO DE BAJADA t_1

$$x = \frac{1}{2} a t^2 = \frac{1}{2} g \sin \alpha \left(1 - \frac{\mu}{\tan \alpha}\right) t^2$$

$$x = \frac{h}{\sin \alpha} \Rightarrow t_1 = \frac{1}{\sin \alpha} \sqrt{\frac{2h}{g(1 - \mu/\tan \alpha)}}$$

TIEMPO DE SUBIDA t_2

DCU



$$-f_r - mg \sin \alpha = ma$$

$$N - mg \cos \alpha = 0$$

$$\Rightarrow a = -g \sin \alpha \left(1 + \frac{\mu}{\tan \alpha}\right)$$

ENTONCES

$$v = v_B + a t = v_B - g \sin \alpha \left(1 + \frac{\mu}{\tan \alpha}\right) t$$

$$v = 0 \Rightarrow v_B = g \sin \alpha \left(1 + \frac{\mu}{\tan \alpha}\right) t_2$$

PERO

$$\frac{1}{2} m v_B^2 = m g h \left(1 - \frac{\mu}{\tan \alpha}\right)$$

$$v_B = \sqrt{2 g h \left(1 - \frac{\mu}{\tan \alpha}\right)}$$

SOLUCIÓN CONTROL 2

$$\therefore t_2 = \frac{\sqrt{2gh(1-\mu/\tan\alpha)}}{g\sin\alpha(1+\mu/\tan\alpha)}$$

TIEMPO PARA LLEGAR A $\tilde{h}$

$$\tilde{t} = t_1 + t_2 = \frac{1}{\sin\alpha} \sqrt{\frac{2h}{g}} \left[\frac{1}{\sqrt{1-\mu/\tan\alpha}} + \frac{\sqrt{1-\mu/\tan\alpha}}{1+\mu/\tan\alpha} \right]$$

TIEMPO PARA IR DE $\tilde{h}$ A h_1

$$\tilde{t}_1 = \frac{1}{\sin\alpha} \sqrt{\frac{2\tilde{h}}{g}} \left[\frac{1}{\sqrt{1-\mu/\tan\alpha}} + \frac{\sqrt{1-\mu/\tan\alpha}}{1+\mu/\tan\alpha} \right]$$

PERO

$$\tilde{h} = h \left(\frac{\tan\alpha - \mu}{\tan\alpha + \mu} \right) = h \left(\frac{1 - \mu/\tan\alpha}{1 + \mu/\tan\alpha} \right)$$

POR LO TANTO, EL TIEMPO PARA COMPLETAR EL CICLO ESTÁ DADO POR

$$T_1 = \tilde{t} + \tilde{t}_1 = \frac{1}{\sin\alpha} \sqrt{\frac{2h}{g}} \left[\frac{1}{\sqrt{1-\mu/\tan\alpha}} + \frac{\sqrt{1-\mu/\tan\alpha}}{1+\mu/\tan\alpha} \right] \times \left[1 + \sqrt{\frac{1-\mu/\tan\alpha}{1+\mu/\tan\alpha}} \right]$$

$$\therefore T_1 = \frac{1}{\sin\alpha} \sqrt{\frac{2h}{g}} \frac{2}{(1+\mu/\tan\alpha)} \left[\frac{1}{\sqrt{1-\mu/\tan\alpha}} + \frac{1}{\sqrt{1+\mu/\tan\alpha}} \right]$$

SOLUCIÓN CONTROL 2

PARA EL CICLO n SE TIENE

$$T_{nti} = \frac{1}{\sec \alpha} \sqrt{\frac{2hn}{g}} \frac{2}{(1 + \mu \tan \alpha)} \left[\frac{1}{\sqrt{1 - \mu \tan \alpha}} + \frac{1}{\sqrt{1 + \mu \tan \alpha}} \right]$$

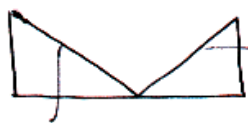
(ii) DISTANCIA TOTAL USANDO TRABAJO FEA. ROCE

$$W_{\text{total roce}} = -\mu mg \cos \alpha D$$

$$\Delta E = W \quad \Rightarrow \quad -mgh = -\mu mg \cos \alpha D$$

$$D = \frac{h}{\mu \cos \alpha}$$

USANDO ALTURAS h_n



$$d_2 = \frac{h}{\sec \alpha} \times 2 = \frac{2h}{\sec \alpha} \left(\frac{1 - \mu \tan \alpha}{1 + \mu \tan \alpha} \right)$$

$$d_1 = \frac{h}{\sec \alpha}$$

$$d_3 = \frac{h_1}{\sec \alpha} = \frac{h}{\sec \alpha} \left(\frac{1 - \mu \tan \alpha}{1 + \mu \tan \alpha} \right)^2$$

SOLUCIÓN CONTROL 2

$$D = \frac{h}{\sin \alpha} + \frac{\tilde{2h}}{\sin \alpha} + \frac{2h_1}{\sin \alpha} + \frac{\tilde{2h_1}}{\sin \alpha} + \frac{2h_2}{\sin \alpha} + \dots$$

$$\text{con } h_n = h \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^n \quad \text{y} \quad \tilde{h}_n = h \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^n$$

$$\therefore D = \frac{h}{\sin \alpha} + \sum_{n=1}^{\infty} \frac{2h}{\sin \alpha} \left(\frac{\tan \alpha - \mu}{\tan \alpha + \mu} \right)^n$$

$$D = \frac{h}{\sin \alpha} \left[1 + 2 \sum_{n=1}^{\infty} \left(\frac{1 - \mu / \tan \alpha}{1 + \mu / \tan \alpha} \right)^n \right]$$

$$D = \frac{h}{\sin \alpha} \left[1 + 2 \left(\frac{1 - \mu / \tan \alpha}{1 + \mu / \tan \alpha} \right) \cdot \frac{1}{1 - \left(\frac{1 - \mu / \tan \alpha}{1 + \mu / \tan \alpha} \right)} \right]$$

$$D = \frac{h}{\sin \alpha} \left[1 + \frac{2(1 - \mu / \tan \alpha)}{2\mu / \tan \alpha} \right]$$

$$D = \frac{h}{\sin \alpha} \cdot \frac{1}{\mu / \tan \alpha} = \frac{h}{\mu \cos \alpha}$$

v) si $\mu > \tan \alpha$ EL BLOQUE NO SE MUEVE

iv) En clase auxiliar