

PHY180 Unit 12

Aspen Erlandsson

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Abstract

1 Rolling Motion

Kinematics of Rolling Down Ramp:

$$\sum F_x = mg\sin\theta - F_x^{static} = ma_a$$

$$\text{No Slip} = R\alpha = a$$

$$\sum \tau_0 = F_x^s R = I\alpha$$

Eliminate F_x^s

$$F_x^s = \frac{I\alpha}{R} = \frac{Ia_x}{R^2}$$

$$mg\sin\theta - \frac{Ia_x}{R^2} = ma_x$$

$$\frac{I}{mR^2} = C$$

$$a_x = g\sin\theta\left(\frac{1}{1 + \frac{I}{mR^2}}\right)$$

$$a = g\sin\theta\left(\frac{1}{1 + c}\right)$$

C is the shape factor determining how the mass is distributed(?).

Filled cylinder: $\rightarrow C = \frac{1}{2}$

Sphere: $\rightarrow C = \frac{2}{5}$