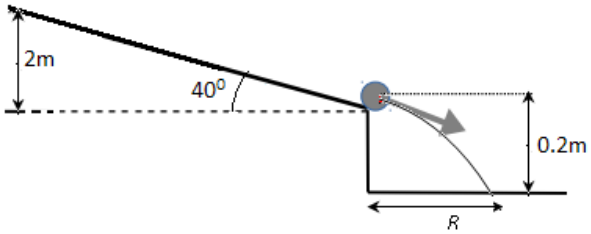
Answer on Question #63557, Physics / Mechanics | Relativity

A cylinder of mass M and radius r rolls down a ramp at height of 2m above the ground and eventually takes off the ramp 20cm above the ground at an angle of 40degrees from the x-axis. Assuming the cylinder didn't slipped as it rolls down, calculate the horizantal range at which the cylinder landed on the ground.

Solution:



Find the speed with which a cylinder rolling on ramp

$$mgh = \frac{mv^2}{2} + \frac{J\omega^2}{2}$$

$$J = \frac{2}{5}mR^2$$

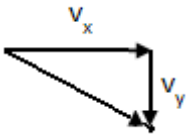
$$\omega = \frac{v}{R}$$

$$mgh = \frac{mv^2}{2} + \frac{v^2}{2R^2} \cdot \frac{2mR^2}{5}$$

$$mgh = \frac{7}{10}mv^2$$

$$v = \sqrt{\frac{10gh}{7}}$$

$$v = \sqrt{\frac{10 \cdot 9.8 \cdot 2}{7}} = 5.3\ m/s$$



$$v_x = vcos40° = 5.3 \cdot 0.77 = 4.1\ m/s$$

$$v_y = vsin40°5.3 \cdot 0.64 = 3.4\ m/s$$

$$\Delta y = v_y t + \frac{1}{2}gt^2$$

$$0.2 = 3.4t + 4.9t^2$$

$$4.9t^2 + 3.4t - 0.2 = 0$$

$$t = 0.055\ s$$

$$\Delta x = v_x t$$

Where $\Delta x = R$, $\Delta x = 4.1 \cdot 0.055 = 0.23\ m$

Answer: 0.23 m