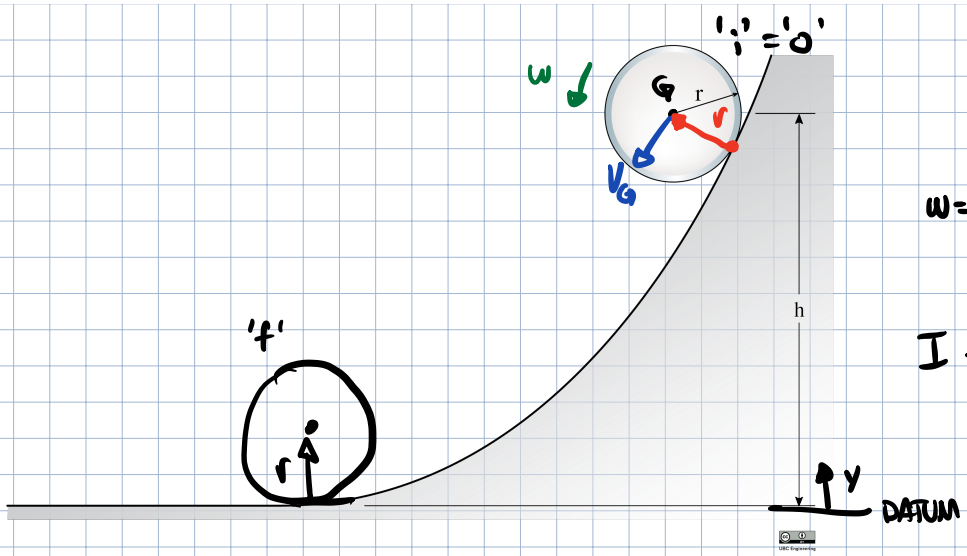
A wheel of radius r = 0.5m is rolling down a hill with an initial velocity of v = 6 m/s (velocity of center of mass). The wheel travels a vertical distance of h=4 m. You need to determine the final velocity of the center of mass of the wheel. Assume the wheel rolls without slipping and there is no energy lost due to friction. (Assume the wheel is a disk of uniform density)



$$w = \frac{V_G}{r}$$

$$I = \frac{1}{2} m r^2$$

$$V_G = mgy$$

$$T = \frac{1}{2} m V_G^2 + \frac{1}{2} I w^2 = \frac{1}{2} m V_G^2 + \frac{1}{2}\left(\frac{1}{2} m r^2\right)\left(\frac{V_G}{r}\right)^2$$

$$= \frac{1}{2} m V_G^2 + \frac{1}{4} m V_G^2 = \frac{3}{4} m V_G^2$$

$$V_o + T_o = V_f + T_f$$

$$mgh + \frac{3}{4} m V_{Go}^2 = mgr + \frac{3}{4} m V_{Gf}^2$$

$$V_{Gf} = \sqrt{\left[(9.81\ m/s^2)(4\ m - 0.5\ m) + \frac{3}{4}(6\ m/s)^2\right]\frac{4}{3}} = \boxed{9.0\ m/s = V_{Gf}}$$