Answer on Question #61861-Physics-Mechanics

1. The rope shown in the figure attached hereto is wound around a cylinder of of mass 4.0 kg, radius 10cm and I= 0020kgm2 , where I is the moment of inertia about an axis along the cylinder axis. If the cylinder rolls without slipping, what the linear acceleration of its center of mass?

Solution

The mass of the cylinder is m = 4.0 kg.

Radius of the cylinder is r = 10 cm = 0.1m.

Moment of inertia of the cylinder is $I = 0.020 kg.m^2$.

The applied force is $F = 4 \cdot 9.8 = 39.2\ N$.

The torque due to the force on the cylinder is τ =Iα.

$$rF = I\alpha$$

$$\alpha = \frac{rF}{I}$$

This is the angular acceleration of the body.

The linear acceleration is

$$a = r\alpha = \frac{r^2 F}{I} = 0.1^2 \cdot \frac{39.2}{0.020} = 19.6 \frac{m}{s^2}.$$

2. Three particles of masses m1=1.2kg, m2=2.5kg and m3=3.4kg are at the vertices of an equilateral triangle of side a = 140 cm. Calculate the center of mass of the system.

Solution

We can simplify calculations by choosing the x and y axes so that one of the particles is located at the origin and the x axis coincides with one of the triangle's sides. The three particles then have the following coordinates:

$$\boldsymbol{c} = \frac{\sum m_i \boldsymbol{r_i}}{\sum m_i}$$

Particle	Mass[kg]	X[cm]	Y[cm]
1	1.2	0	0
2	2.5	140	0
3	3.4	70	121

Total mass of the system $\sum m_i$= 7.1 kg.

The coordinates of the center of mass are

$$x_c = \frac{1.2(0) + 2.5(140) + 3.4(70)}{7.1} = 83\ cm.$$

$$y_c = \frac{1.2(0) + 2.5(0) + 3.4(121)}{7.1} = 58\ cm.$$