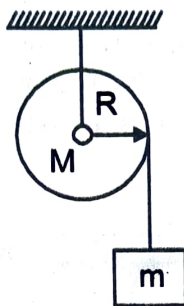


A block of mass m is attached at the end of an inextensible string which is wound over a rough pulley of mass M and radius R . Assume the string does not slide over the pulley. Find the acceleration of the block when released.

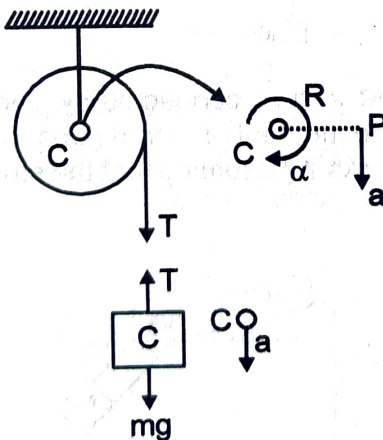


Solution :

This problem is different from the problems which we have solved in laws of motion where we assumed the string is sliding over the pulley without friction. Here, the pulley is rough and string is not sliding. We will go step by step to analyse the situation.

Equation of motion of the block :

$$mg - T = ma \quad \dots(i)$$



Torque equation for the pulley : $\tau_c = I_c \alpha$

$$TR = \left(\frac{MR^2}{2} \right) \alpha \Rightarrow \alpha = \frac{2T}{MR} \quad \dots\text{(iii)}$$

The acceleration of the block is downwards; hence, acceleration of the point P will also be downwards.
After solving Eqs. (i), (ii) and (iii), we get

$$a = \frac{2mg}{2m + M}$$