D' Alembert's' Principle Applicable to Rotary Motion.

It states that when external torques (active torque) acts on a system having rotating motion, then the algebraic sum of all the torques acting on the system due to external forces and reversed active forces including the inertia torque is zero.

1. A weight of 5N is suspended by a light rope wound around a pulley of weight 50N and radius 30cm, the other end of the rope being fixed to the periphery of the pulley. If the weight is moving downwards determine

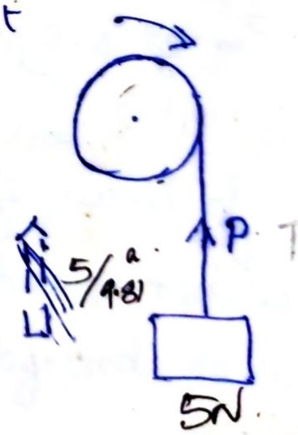
i) the acceleration of the weight 5N and

ii) the tension in the string Take $g = 9.8\ m/s^2$.

$W = 5N$ $a \rightarrow$ acceln. of weight

$W_0 = 50N$ $P\ T \rightarrow$ Tension.

$R = 0.3$



Consider the motion of 5N

Net Force = ma

$$5 - P = \frac{5}{9.81} a \longrightarrow (1)$$

Consider the rotation of pulley

Net torque = $I\alpha$

1.C. Lab 1pm

$$PR = \frac{MR^2}{2} \times \frac{a}{R}$$

$$a = \frac{gW}{\left(W + \frac{W_0}{2}\right)} \; m/s^2$$

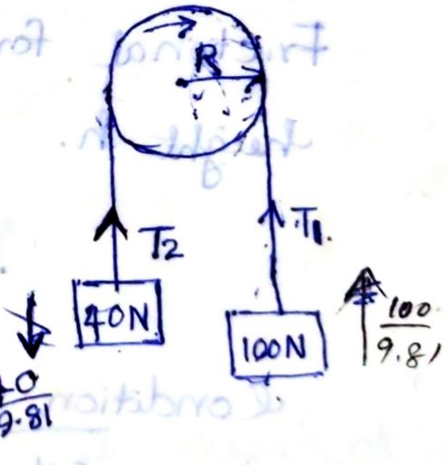
$$PR = \frac{MR}{2} a$$

$$P = \frac{Ma}{2} = \frac{50}{2 \times 9.81} \times a \quad —②$$

$$① + ② \Rightarrow a = 1.633 m/s^2 \quad \left(T = \frac{WW_0}{(2W + W_0)} \right).$$

$$P = 4.166 N$$

2. Two blocks weighing 100N & 40N are supported at the ends of a rope of negligible wt. which is passing over a rough surface of a pulley mounted on a horizontal axle. The pulley may be assumed as a solid disc with a weight of 50N. Friction in the bearings of the pulley may be neglected. Find the tension on the two parts of the two rope and the linear acceln. of the blocks.



Consider motion of 100N

Net force = ma

$$100 - T_1 = \frac{100}{9.81} \times a \quad —①$$

Consider motion of 40N

$$T_2 - 40 = \frac{40}{9.81} \times a \quad — ②$$

Consider rotation of pulley

Net torque = $I\alpha$

$$T_1 R - T_2 R = \frac{MR^2}{2} \times \frac{a}{R}$$

$$(T_1 - T_2) R = \frac{MR}{2} a$$

$$(T_1 - T_2) = \frac{Ma}{2} = \frac{50}{9.81 \times 2} \times a \quad \longrightarrow (3)$$

$W_1 > W_2$

(1) + (2) + (3) ⇒ T_1 & T_2 eliminated

$a = 3.567 \ m/s^2$

$T_1 = 63.636 N$

$T_2 = 54.545 N$

$$T_1 = \frac{W_1 \left[2W_2 + W_0/2 \right]}{W_1 + W_2 + W_0/2}$$

$$T_2 = \frac{W_2 \left[2W_1 + W_0/2 \right]}{W_1 + W_2 + W_0/2}$$