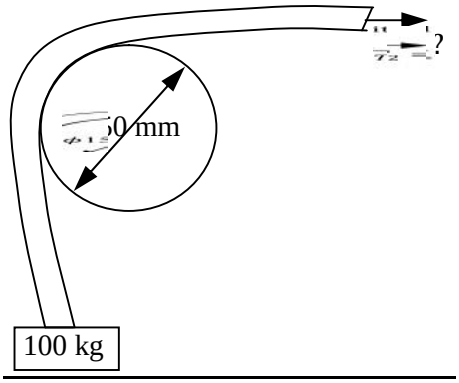
Problem 13:

A mass of 100kg is lifted by a rope on a cylinder of 150mm diameter as shown in Figure. The coefficient of friction is 0.20 and velocity 30 m/s calculate,

(i) The necessary force to be applied to lift the load

(ii) The Torque at the cylinder surface

(iii) Power transmitted



Solution :

Given $T_1 = 100 \times 9.81 = 981\ N$

Angle of contact $\theta = 90^0$

$$= 90^0 \times \frac{\pi}{180}\ rad$$

$$= \frac{\pi}{2}\ rad$$

Using the equation,

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

$$= e^{\left(0.2 \times \frac{\pi}{2}\right)} = \frac{981}{T_2}$$

$$T_2 = 716.58\ N$$

$$\text{Torque} = (T_1 - T_2) \times \text{radius}$$

$$\text{Torque} = (981 - 716.58) \times \left(\frac{0.15}{2}\right)$$

$$= 19.83\text{Nm}$$

$$\text{Power transmitted} = (T_1 - T_2) \times V$$

$$= (981 - 716.58) \times 30$$

$$= 7932.6\ \text{Nm/s}$$