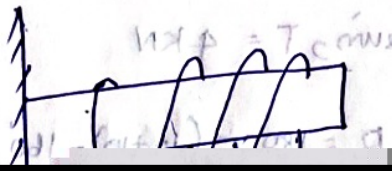
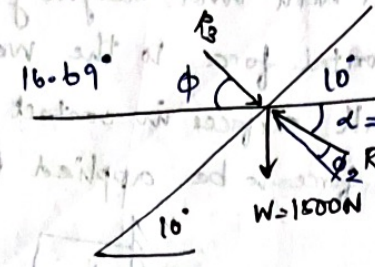
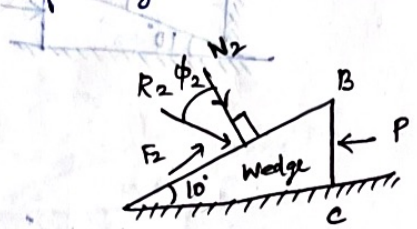
(P) A rope is wrapped 3 times around a rod as shown. Determine the force required on the free end of the rope to support a load of 20 kN weight. The coeff of friction between the rope & rod is 0.30

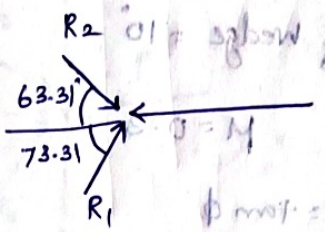
Soln :-





FBD of wedge. (Wedge)





$\Sigma V = 0 \quad (\uparrow +)$

$R_1 \sin 73.31 - R_2 \sin 63.31 = 0$

$R_1 \sin 73.31 = R_2 \sin 63.31$

$R_1 \sin 73.31 = 1977 \sin 63.31$

$$\boxed{R_1 = 1846\ N}$$

$\Sigma H = 0 \quad (\rightarrow +)$

$R_2 \cos 63.31 + R_1 \cos 73.31 - P = 0$

$1977 \cos 63.31 + 1846 \cos 73.31 = P$

$$\boxed{P = 1431\ N}$$

Belt Friction :

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

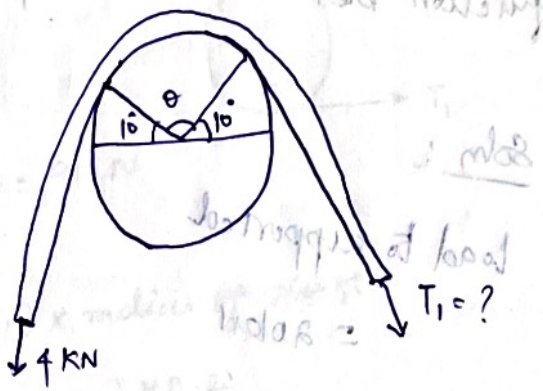
θ = angle of Contact

μ = coeff. of friction.

Torque = $(T_2 - T_1) \times$ radius of shaft

Power Transmitted = $(T_2 - T_1) \times$ velocity of belt.

(7) A rope is wound over a pulley as shown. If the tension which pulls the belt on one end is 4 kN, determine the neceessary tension on other side of the belt to resist? Take $\mu = 0.25$



Tension, $T = 4$ kN

$\theta = 180 - (10+10) = 160°$

$\theta = \left(\frac{160 \times \pi}{180}\right)$ radians

$= 2.792$ rad

T_1 is the neceessary tension on the other side to resist

$$T_2 = T_1 e^{\mu\theta} \quad (\text{or}) \quad T_1 = \frac{T_2}{e^{\mu\theta}}$$

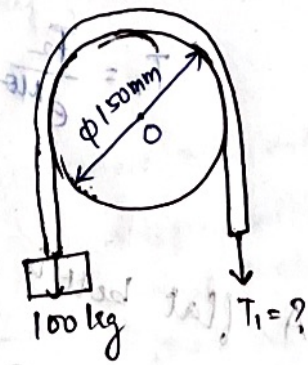
$$T_1 = \frac{4}{e^{(0.25 \times 2.792)}} = 2\text{ kN}$$

(8) A 100 kg mass is lifted by a rope rolling on a cylinder of 150 mm dia as shown. Determine the force required on the otherside if the coeff of friction is 0.20

$T_2 = 100$ kg $= 100 \times 9.81$ N

$T_1 = ?$

contact angle $\theta = 180° = \frac{180 \times \pi}{180} = \pi$ rad.



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

$$T_1 = \frac{T_2}{e^{\mu\theta}} = \frac{100 \times 9.81}{e^{(0.20 \times \pi)}}$$

$= 523.48$ N.