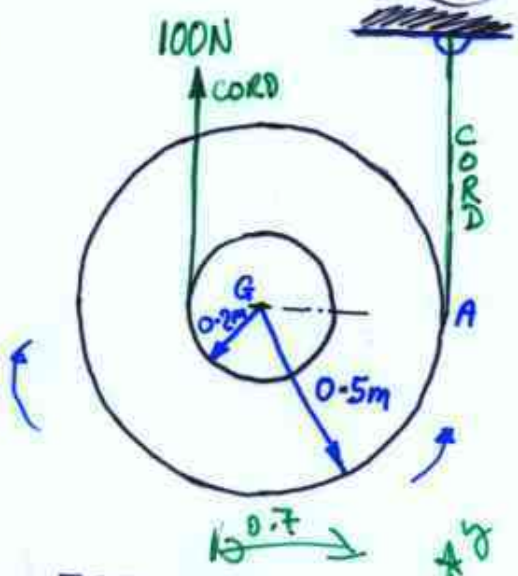
F9

EXAMPLE: A SPOOL HAS $m = 8\,kg$ radius of gyration $k_G = 0.35m$ if LIGHT CORDS ARE WRAPPED around INNER & OUTER HUBS AS SHOWN, find α for spool

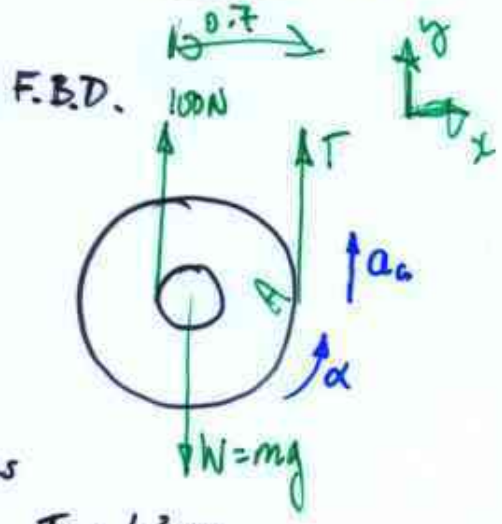


$\sum F_y = m a_{G_y}$ ①

(+↑) $T + 100(N) - mg = m a_G$ N

$\sum M_G = I_G \alpha$

$-(100)(0.2) + (T)(0.5) = k_G^2 m \alpha$ ② Nm



Kinematics can relate a_G & α

assume spool "rolls without slipping" on cord at A

$a_G = -\alpha r = -0.5\alpha$ ③

⇒ can solve our 3 eqns in 3 unknowns

$I_G = k_G^2 m$

Eqn ② rearranges to give

$$T = \frac{k_G^2 m \alpha + (100)(0.2)}{0.5} = 2k_G^2 m \alpha + 40$$

So ① becomes

$$[2k_G^2 m \alpha + 40] + 100 - mg = m(-0.5\alpha)$$

$$\Rightarrow \alpha = \frac{-40 + mg - 100}{2k_G^2 m + \frac{1}{2}m} = -10.3\ rad\,s^{-2}$$

then $a_G = 5.16\ m s^{-2}$ & $T = 19.8\,N$