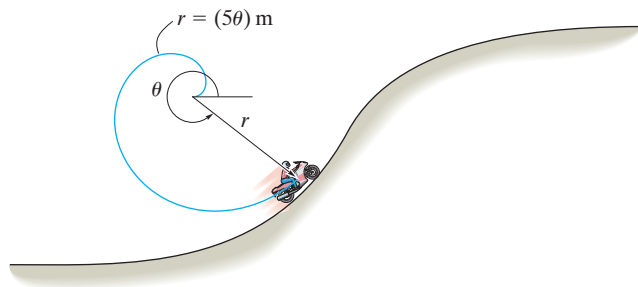


13-94.

Determine the normal and frictional driving forces that the partial spiral track exerts on the 200-kg motorcycle at the instant $\theta = \frac{5}{3}\pi$ rad, $\dot{\theta} = 0.4$ rad/s, and $\ddot{\theta} = 0.8$ rad/s². Neglect the size of the motorcycle.



SOLUTION

$$\theta = \left(\frac{5}{3}\pi\right) = 300^\circ \quad \dot{\theta} = 0.4 \quad \ddot{\theta} = 0.8$$

$$r = 5\theta = 5\left(\frac{5}{3}\pi\right) = 26.18$$

$$\dot{r} = 5\dot{\theta} = 5(0.4) = 2$$

$$\ddot{r} = 5\ddot{\theta} = 5(0.8) = 4$$

$$a_r = \ddot{r} - r\dot{\theta}^2 = 4 - 26.18(0.4)^2 = -0.1888$$

$$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} = 26.18(0.8) + 2(2)(0.4) = 22.54$$

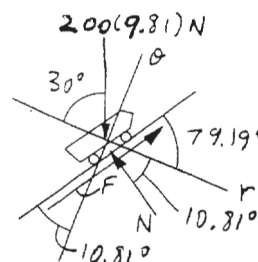
$$\tan \psi = \frac{r}{dr/d\theta} = \frac{5\left(\frac{5}{3}\pi\right)}{5} = 5.236 \quad \psi = 79.19^\circ$$

$$+\searrow \Sigma F_r = ma_r; \quad F \sin 10.81^\circ - N \cos 10.81^\circ + 200(9.81) \cos 30^\circ = 200(-0.1888)$$

$$+\nearrow \Sigma F_\theta = ma_\theta; \quad F \cos 10.81^\circ - 200(9.81) \sin 30^\circ + N \sin 10.81^\circ = 200(22.54)$$

$$F = 5.07 \text{ kN} \quad \text{Ans.}$$

$$N = 2.74 \text{ kN} \quad \text{Ans.}$$



Ans:
 $F = 5.07 \text{ kN}$
 $N = 2.74 \text{ kN}$