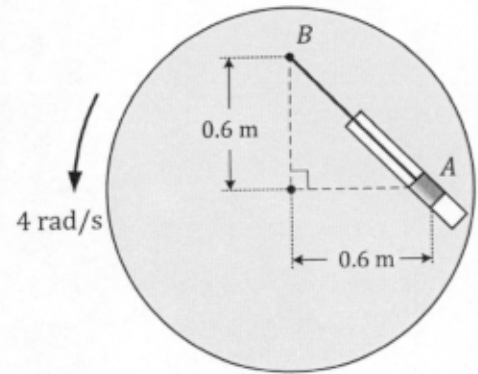


Question 2:

(2 Marks)

The circular disc lies in the horizontal plane and rotates with a constant counterclockwise angular velocity of 4 rad/s. The 0.5 kg slider A is supported by the smooth slot and the string attached at B. Determine the tension (T) in the string and the magnitude of the normal force (N) exerted on the slider by the slot.

$$a_c \equiv \text{centrifugal acceleration}$$



Solution:

(a) Present your solution to Question 2 here (include any diagrams needed to support your solution):

$m_A = 0.5 \text{ kg}$, $T_{AB} = ?$, $N_A = ?$

FBD A:

$\sum F_n = m a_n$
 $-T \cos 45^\circ + N \cos 45^\circ = m r \omega^2$
 $-T \cos 45^\circ + N \cos 45^\circ = 0.5 \times 0.6 \times 4^2$
 $\therefore \frac{N}{\sqrt{2}} - \frac{T}{\sqrt{2}} = \frac{24}{5}$ — (1)

$\sum F_t = m a_t$
 $\sum F_y = 0$
 $T \sin 45^\circ + N \sin 45^\circ = 0$

$\sum F_n = m a_n$
 $-T \cos 45^\circ + N \sin 45^\circ = m r \omega^2 = 0.5 \times 0.6 \times 4^2 = 4.8$
 $\therefore \frac{T}{\sqrt{2}} - \frac{N}{\sqrt{2}} = -4.8$ — (2)

$\sum F_y = m a_y$
 $T \sin 45^\circ + N \cos 45^\circ = 0$
 $\therefore \frac{T}{\sqrt{2}} + \frac{N}{\sqrt{2}} = 0$
 $-T = N$ — (3)

$\therefore T = 3.39 \text{ N}$ $\therefore N = -3.39 \text{ N}$ $N = 3.39 \text{ N}$



(b) On the same disc a Point P is defined at the circumference as shown. At this instant the slider A is moving towards B with a velocity of $v_A = 2.5 \text{ m/s}$. Determine the velocity ($v_{P/A}$) of P as observed from A.

$$\vec{v}_{P/A} = \vec{v}_P - \vec{v}_A, \quad \vec{v}_A = 2.5 \text{ m/s}, \quad \vec{v}_P = ?$$

$$\begin{aligned} \vec{a}_c &= r \omega^2 \\ &= 0.8 \times 4^2 \\ &= 12.8 \text{ m/s}^2 \end{aligned}$$

$$\vec{a}_c = \frac{v^2}{r}$$

$$12.8 \times 0.8 = v_P^2$$

$$\therefore v_P = 3.2 \text{ m/s} \quad \swarrow 45^\circ$$

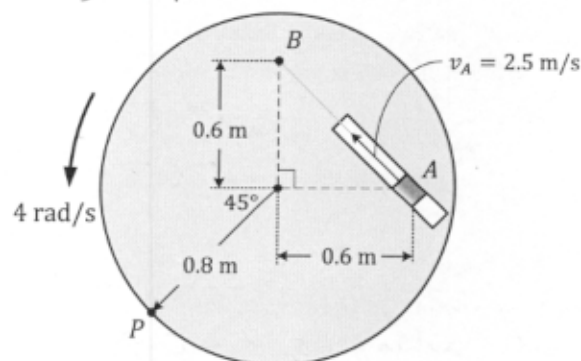
$$\therefore \vec{v}_{P/A} = 3.2 - 2.5$$

$$\swarrow 45^\circ - \swarrow 45^\circ$$

$$= 3.2 + 2.5$$

$$\swarrow - \swarrow$$

$$= 5.7 \text{ m/s} \quad \swarrow 45^\circ$$



Answers:

$$T = 3.39 \text{ N}$$

$$N = 3.39 \text{ N}$$

$$v_{P/A} = 5.7 \text{ m/s}$$



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