1. (30) The T-shaped body rotates about a horizontal axis through pin $O$. At the instant shown, its angular velocity is $\omega = 3 \text{ rad/s}$ and its angular acceleration is $\dot{\alpha} = 14 \text{ rad/s}^2$ in the directions indicated. Determine the velocity and acceleration of points $A$ and $B$. Express your results as components along the $n$- and $t$-directions.

2. (30) Rotation of the lever $OC$ is controlled by the motion of the contacting circular disc whose center is given a horizontal velocity $v$. Determine an expression for the angular velocity $\omega$ of the lever $OC$ in terms of $v, x$ and $r$. Determine also the angular velocity $\omega_t$ of the disc assuming it does not slip on the lever.

3. (40) The 10-kg wheel with a radius of gyration of 180 mm about its center $G$ is released from rest on the $60^\circ$ incline. If the static and kinetic coefficients of friction are $\mu_s = 0.4$ and $\mu_k = 0.3$, respectively, calculate the acceleration $a_G$ of the center $G$ of the wheel and its angular acceleration $\alpha$. How large would the coefficient of static friction $\mu_s$ have to be in order to have rolling without slipping?

**Useful equations**

\[
\begin{align*}
\tilde{v}_B &= \tilde{v}_A + \tilde{v}_{B/A} = \tilde{v}_A + \omega \times \tilde{r}_{B/A} \\
\tilde{a}_B &= \tilde{a}_A + \tilde{a}_{B/A} = \tilde{a}_A + \left( \tilde{a}_{B/A} \right)_n + \left( \tilde{a}_{B/A} \right)_t \\
(a)_t &= r\alpha \quad (a)_n = r\omega^2 \\
\sum \tilde{F} &= m\tilde{a}_G \quad \sum \tilde{M}_G = I_G\ddot{\alpha} \\
I &= mk^2
\end{align*}
\]