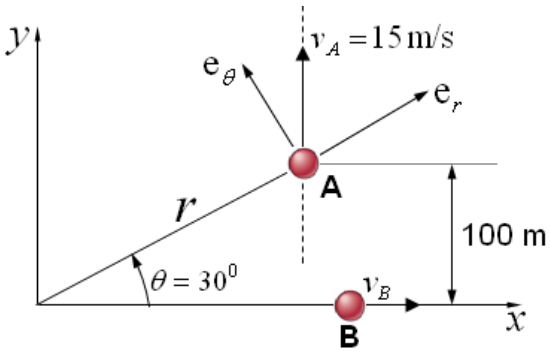
# KING SAUD UNIVERSITY
## College of Engineering
## Mechanical Engineering Department

**GE 202 DYNAMICS** **Summer Term Final Exam 15/8/1431H (25/8/2010 G)**
(Duration of exam: 3 hours)

**Problem 1:**
The velocity and acceleration of particle A are known as $\vec{v}_A = 15\,\vec{j}$ (m/s) and $\vec{a}_A = 12\,\vec{e}_r\ (\text{m/s}^2)$ when $\theta = 30^0$. At this instant




**a)** Determine the values of $\dot{r}$, $\dot{\theta}$ and $\ddot{\theta}$ for particle A.

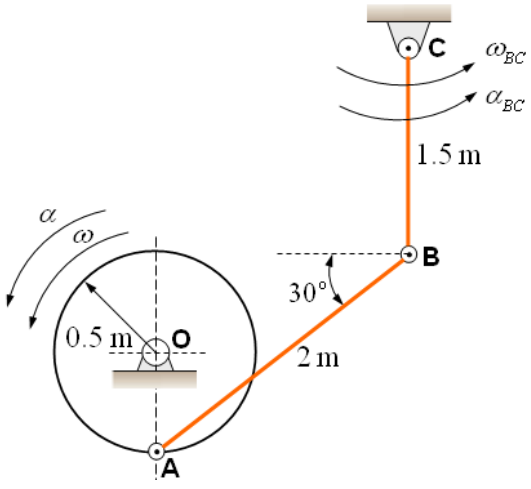
**Note:** $a_r = \ddot{r} - r\left(\dot{\theta}\right)^2$, $a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$

$v_r = \dot{r}$, $v_\theta = r\dot{\theta}$

**b)** Find $a_n$ and $a_t$ for particle A.

**c)** Now consider particle B, which moves along x-direction with constant velocity of 20 (m/s). Determine $\vec{v}_{A/B}$ and $\vec{a}_{A/B}$ at the shown instant.

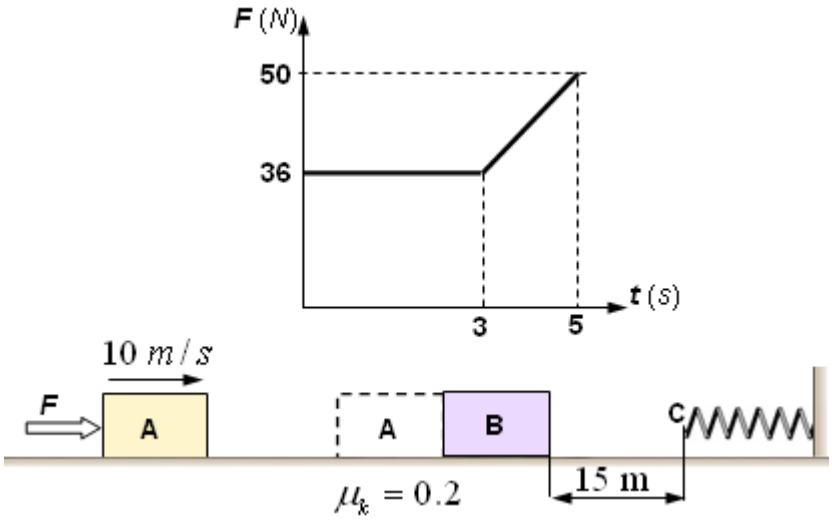
**Problem 2:**
The disk is rotating about a fixed point O with an angular velocity $\omega = 5\,\text{rad/s}$ and an angular acceleration $\alpha = 6\,\text{rad/s}^2$ CCW direction. For the shown instant determine




**a)** The angular velocities of links *AB* and *BC*,
$\omega_{AB} = ?\,, \omega_{BC} = ?$

**b)** The angular accelerations of links *AB* and *BC*,
$\alpha_{AB} = ?\,, \alpha_{BC} = ?$

**Problem 3:**




The 16-kg block, moving with velocity $v = 10\,\text{m/s}$ at time $t$=0s, is acted on by a horizontal force which varies with time $t$ as shown. When time $t$=5s block A collides to 20-kg initially stationary block B. If the coefficient of restitution for the collision is $e$=0.7 and kinetic friction coefficient is $\mu_K = 0.2$ determine

**a)** The velocity of block A at $t$=3 s.
**b)** The linear impulse of block A just before the collision with block B.
**c)** The velocities of block A and B after collision.
**d)** If the spring stiffness is 2 N/m then the maximum deformation of the spring caused from block B.

**Problem 4:**

The uniform slender bar has a mass of 30-kg and is released from rest in the vertical position shown under a constant moment $M = 20\,\text{Nm}$. The spring stiffness is 150 N/m and its unstretched length is 0.3 m. Calculate the velocity with which end $A$ strikes the horizontal surface, $v_A = ?$

Note: $I_0 = \frac{1}{3} m L^2$, where $m$ is the mass and $L$ is the length of the slender bar.