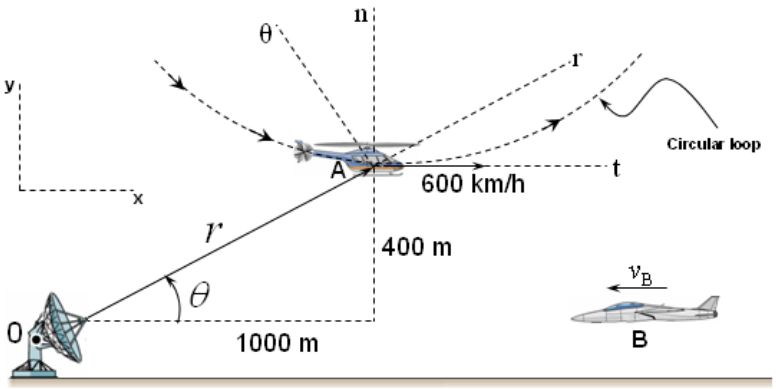
KING SAUD UNIVERSITY
College of Engineering
Mechanical Engineering Department

GE 202 DYNAMICS **Final Exam** **12/2/1432H (16/1/2011 G)**
(Duration of exam: 3 hours)

Problem 1:



At the bottom of a circular loop in the vertical plane, at an altitude of 400 m, the helicopter **A** has a constant velocity of 600 km/h. The radius of curvature of the circular loop is 1200 m. For the radar tracking at **O**, determine

a) r-θ components of the velocity of helicopter **A**, $v_r = ?,\ v_\theta = ?$

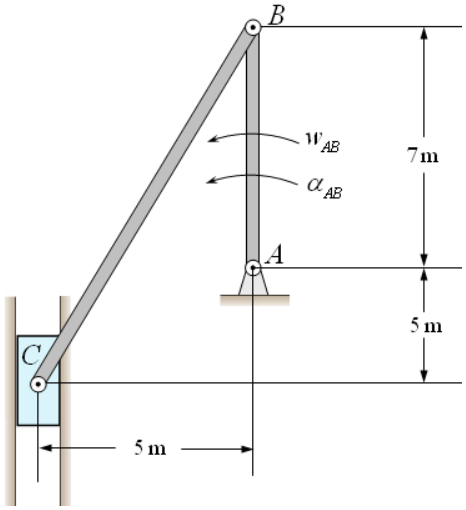
b) r-θ components of the acceleration of helicopter **A**, $a_r = ?,\ a_\theta = ?$

c) Now consider another airplane **B**, which moves in x-direction with velocity of 800 km/h and acceleration of $15\,\text{m/s}^2$. Determine $\vec{v}_{A/B}$ and $\vec{a}_{A/B}$ at the shown instant.

Note: for this question you don't need to use formulas of a_r and a_θ

Problem 2:

In figure the vertical link *AB* has an angular velocity of $\omega_{AB} = 3\,\text{rad/s}$ and an angular acceleration of $\alpha_{AB} = 2\,\text{rad/s}^2$ as shown. At the shown instant:



a) Show the instantaneous center of the link *BC*?

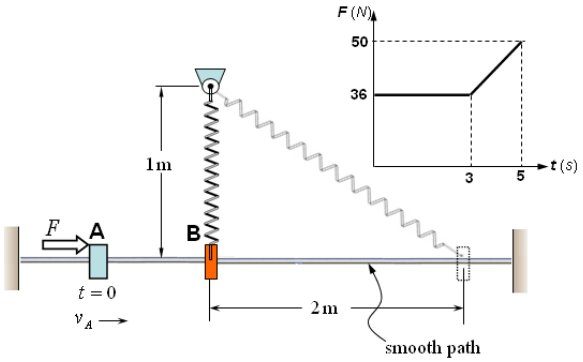
b) Calculate the angular velocity and angular acceleration of link *BC*, $\omega_{BC} = ?,\ \alpha_{BC} = ?$

c) Calculate the velocity and acceleration vectors of slider block *C*, $v_C = ?, a_C = ?$

Problem 3:

In the shown instant the 20-kg slider **B** at rest with attached unstretched spring.
The 10 kg slider **A** moving with $v = 10\,\text{m/s}$ at time t=0s, is acted upon by a horizontal force F which varies with time t as shown.

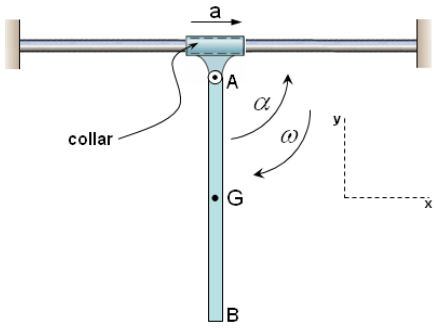
When time t=5s slider **A** collides to stationary slider **B**. The coefficient of restitution for the collision is e=0.7. Under these conditions



a) Calculate the velocity of slider **A** just before colliding **B**.
b) Calculate the velocity of slider **B** just after collision.
c) Find the spring stiffness k so that the slider **B** stops at 2-m distance along the smooth guide?

Problem 4:

End **A** of the uniform 50-kg bar is pinned freely to the collar, which has an acceleration **a** along the fixed horizontal shaft as shown. The bar has a clockwise angular velocity $\omega = 4\,\text{rad/s}$ and a counter clockwise angular acceleration of $\alpha = 1\,\text{rad/s}$. At the shown instant when the bar **AB** is vertical:



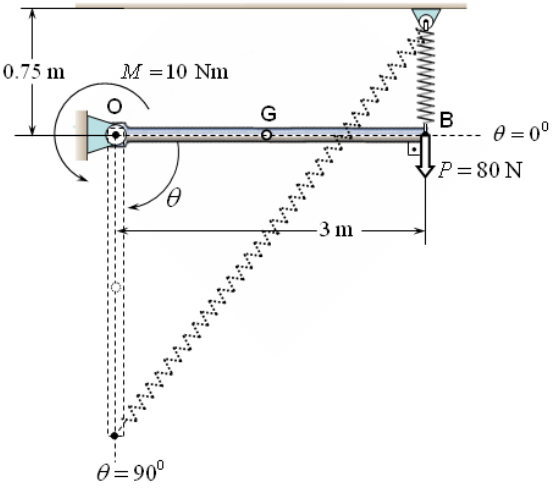
a) Draw the Free Body and Kinetics Diagrams
b) Calculate the acceleration of the collar a = ?
c) Find the reaction force at **A**?

Given: $I_G = \frac{1}{12} m\ l^2$, where m is the mass and l is the length of the bar.

Problem 5:

A 3-meter long uniform slender bar OB has a mass of 12-kg and is subjected to an external moment of $M = 10\ \text{Nm}$ and an external force of $P = 80\ \text{N}$, which is always applied perpendicular to the end of the bar.

The spring stiffness is k=30 N/m. Also the spring has an unstretched length of 0.5m. When $\theta = 0^0$ the bar is released from rest. Calculate the angular velocity of the bar as the position $\theta = 90^0$ is passed.



Given: $I_O = \frac{1}{3} m\, l^2$, where m is the mass and l is the length of the bar.

Note: There is no friction in the system.

GOOD LUCK