

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

**GE 202 DYNAMICS**

**Final Exam**

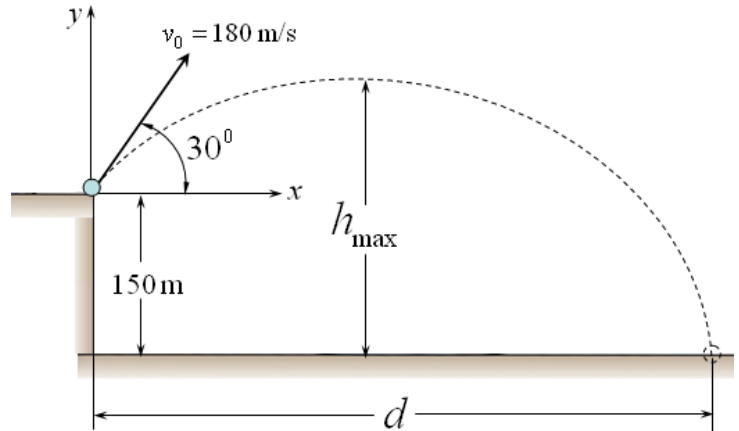
**19 / 9 / 1433**

(Duration of exam: 3 hours)

**Problem 1**

A projectile is fired from the edge of a 150m cliff with an initial velocity of 180 m/s at an angle of  $30^\circ$  with the horizontal. Find

- the horizontal distance from the gun to the point where the projectile strikes the ground,  $d = ?$
- the greatest elevation above the ground reached by the projectile,  $h_{\max} = ?$

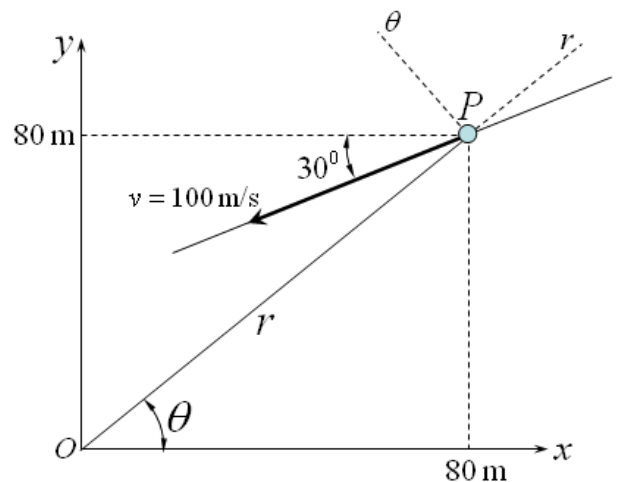


**Problem 2**

As it passes the position shown, the particle  $P$  has a constant speed  $v = 100$  m/s along the straight line shown. Determine the corresponding values of

- $\dot{r} = ?$ ,  $\dot{\theta} = ?$
- $\ddot{r} = ?$ ,  $\ddot{\theta} = ?$

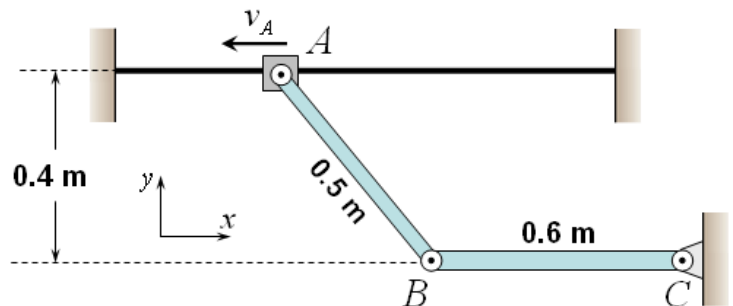
**Note:**  $v_r = \dot{r}$ ,  $v_\theta = r\dot{\theta}$ ,  $a_r = \ddot{r} - r(\dot{\theta})^2$ ,  $a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$



**Problem 3**

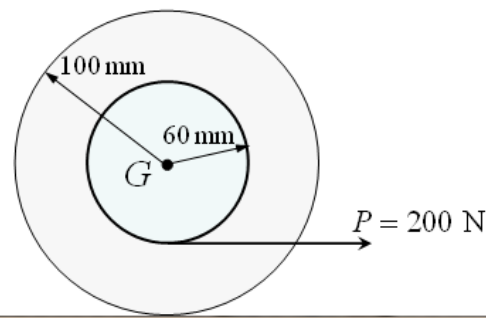
When the mechanism is in the position shown, the velocity of the sliding collar is  $v_A = 2.4$  m/s, and it is increasing at the rate of  $a_A = 0.8$  m/s<sup>2</sup>. For this position

- Calculate the *angular acceleration* of bar  $AB$ ?
- Calculate the *angular acceleration* of bar  $BC$ ?



### Problem 4

A cord is wrapped around the inner drum of a wheel and pulled horizontally with a force of  $P = 200 \text{ N}$ . The wheel has a mass of  $100 \text{ kg}$  and a radius of gyration of  $k_G = 70 \text{ mm}$ . Knowing that  $\mu_s = 0.20$  and  $\mu_k = 0.15$

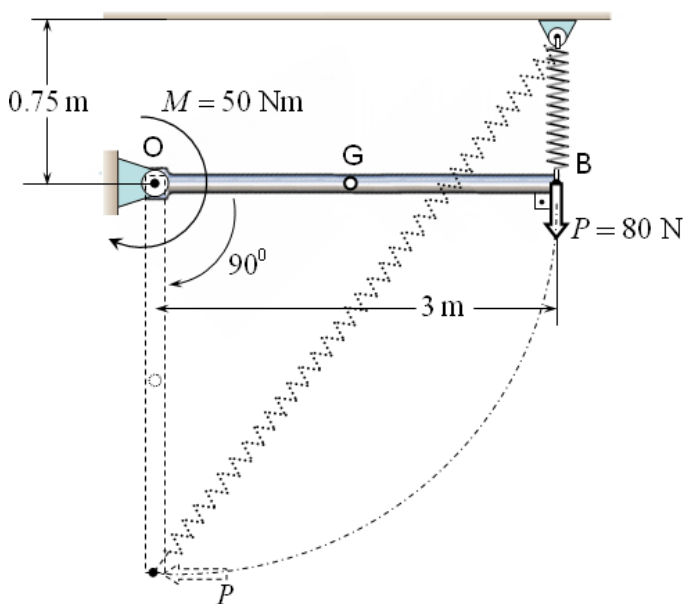


- Plot the FBD and Kinetic Diagrams.
- Calculate the acceleration of mass center  $G$ ,  $a_G = ?$
- Calculate the angular acceleration of the wheel,  $\alpha = ?$

**Note:**  $I_G = mk_G^2$ , where  $m$  is the mass.

### Problem 5

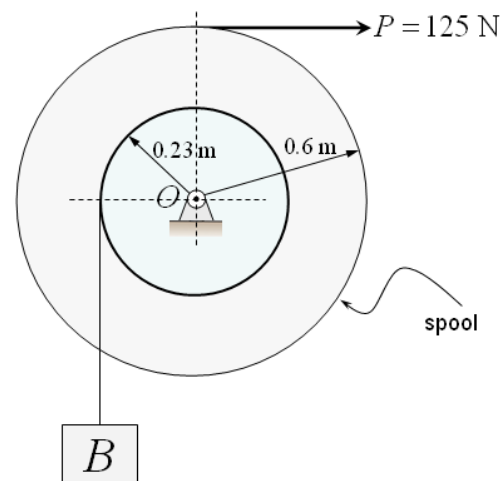
Initially at rest, a 3-meter long uniform slender bar  $OB$  has a mass of  $10 \text{ kg}$  and is subjected to an external moment of  $M = 50 \text{ Nm}$  and an external force of  $P = 80 \text{ N}$ , which is always applied perpendicular to the end of the bar. The spring stiffness is  $k = 30 \text{ N/m}$ , also the spring has an unstretched length of  $0.5 \text{ m}$ . Determine the bar's angular velocity  $\omega = ?$  when it is released and rotated in a vertical plane downward  $90^\circ$ .



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

### Problem 6

The spool has a mass of  $40 \text{ kg}$  and a radius of gyration  $k_O = 0.36 \text{ m}$ . If the block  $B$  has a mass of  $30 \text{ kg}$  and a force  $P = 125 \text{ N}$  is applied to the cord, determine the speed of the block  $v = ?$  in 5 seconds starting from rest. Neglect the mass of the cord.



GOOD LUCK