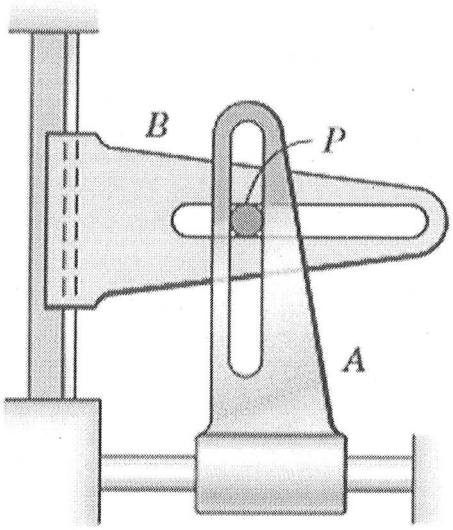
B.E. MECHANICAL ENGINEERING SECOND YEAR FIRST SEMESTER SUPPLEMENTARY EXAM 2023

ENGINEERING DYNAMICS

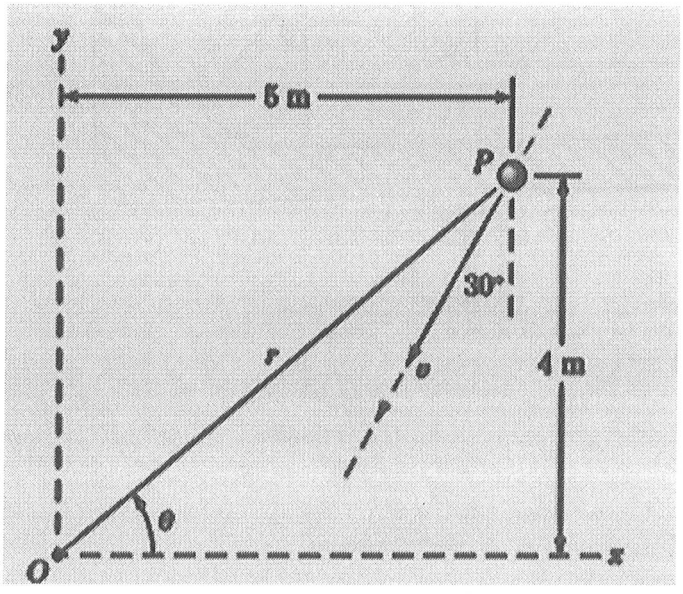
Time: 3 Hours Ful Marks: 100

Assume any missing data suitably. Take Acceleration due to gravity, $g = 9.81$ m/s^2

Q1(a) The pin **P** is constrained to move in the slotted guides which move at right angles to one another. At the instant represented, **A** has a velocity to the right of **0.2 m/s** which is decreasing at the rate of **0.75 m/s** each second. At the same time, **B** is moving down with a velocity of **0.15 m/s** which is decreasing at the rate of **0.5 m/s** each second. For this instant determine the radius of curvature of the path followed by **P**. Refer to the following figure. 10

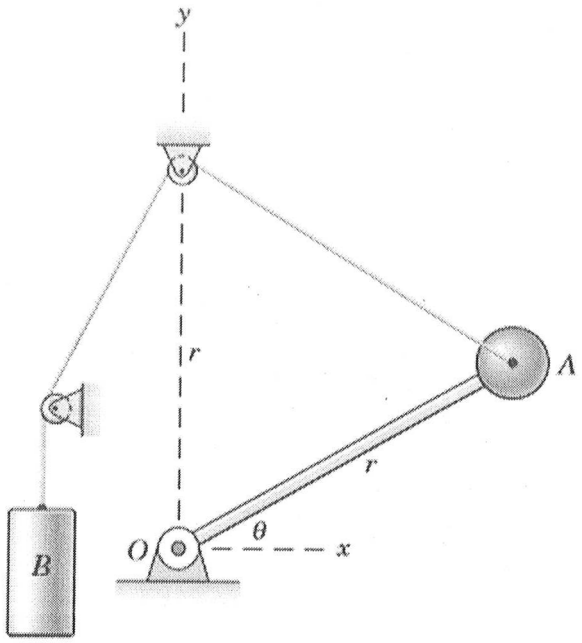


Q1(b) The sphere **P** travels in a straight line with speed v **=10 m/s** . For the instant depicted, determine the corresponding values of $\dot{r}$ and $\dot{\theta}$ as measured relative to the fixed **Oxy** coordinate system. Refer to the following figure. 10

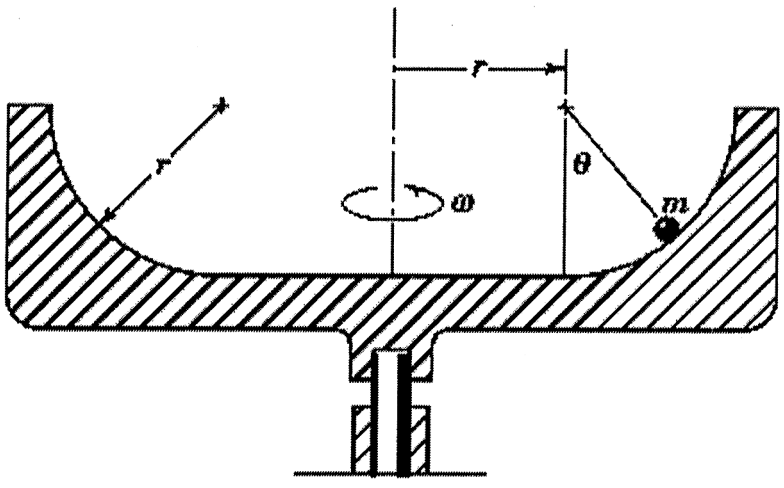


Ex/ME(M2)/PC/B/T/212/2023(S)
Full Marks : 100
Time: 3.0 Hrs

Q2(a) Refer to the following figure. The particle **A** is mounted on a light rod pivoted at **O** and therefore is constrained to move in a circular arc of radius ***r***. Determine the velocity of **A** in terms of the downward velocity of the counterweight for any angle θ. 10

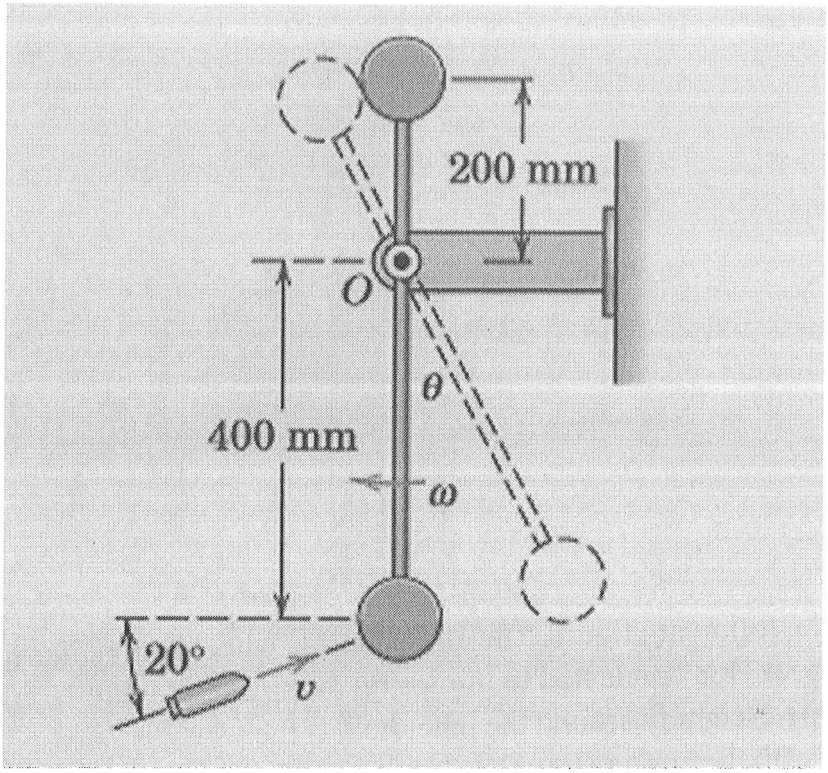


Q2(b) The bowl-shaped device rotates about a vertical axis with a constant angular velocity ω. If the particle is observed to approach a steady-state position $\theta = 40^0$ in the presence of a very small amount of friction, determine ω. The value of ***r*** is **0.2 m**. Refer to the following figure. 10

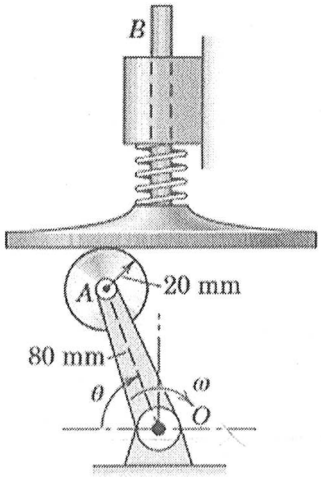


Ex/ME(M2)/PC/B/T/212/2023(S)
Full Marks : 100 Time: 3.0 Hrs

Q3. A pendulum consists of two **3.2-kg** concentrated masses positioned as shown on a light but rigid bar. The pendulum is swinging through the vertical position with a **clockwise** angular velocity ω = **6 rad/s** when a **50-g** bullet traveling with velocity v = **300 m/s** in the direction shown strikes the lower mass and becomes embedded in it. Calculate the angular velocity which the pendulum has immediately after impact and find the maximum angular deflection θ of the pendulum. Refer to the following figure. 20



Q4. Refer to the following figure. Determine the acceleration of the shaft **B** for θ=60° if the crank **OA** has an angular acceleration $\ddot{\theta} = 8$ **rad/s²** and an angular velocity $\dot{\theta} = 4$ **rad/s** at this position. The spring maintains contact between the roller and the surface of the plunger. 20

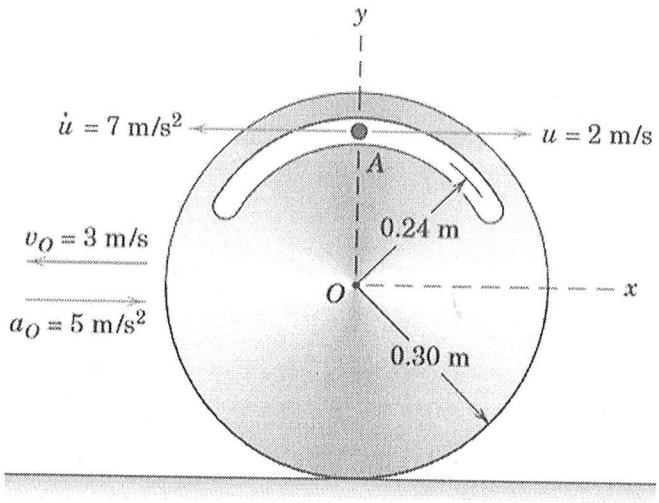


$\theta = 60°$, $\dot{\theta} = 4$ rad/s
$\ddot{\theta} = 8$ rad/s²

Ex/ME(M2)/PC/B/T/212/2023(S)
Full Marks : 100
Time: 3.0 Hrs

Q5. The disk rolls without slipping on the horizontal surface, and at the instant represented, the center **O** has the velocity and acceleration shown in the figure. For this instant, the particle **A** has the indicated speed u and time rate of change of speed $\dot{u}$, both relative to the disk. Determine the absolute velocity and acceleration of particle **A**. Refer to the following figure.

20



Q6. Refer to the following figure. The **10-kg** double wheel with radius of gyration of **125 mm** about **O** is connected to the spring of stiffness k=**600 N/m** by a cord which is wrapped securely around the inner hub. If the wheel is released from rest on the incline with the spring stretched **225 mm**, calculate the maximum velocity v_{max} of its center **O** during the ensuing motion. The wheel rolls without slipping.

20