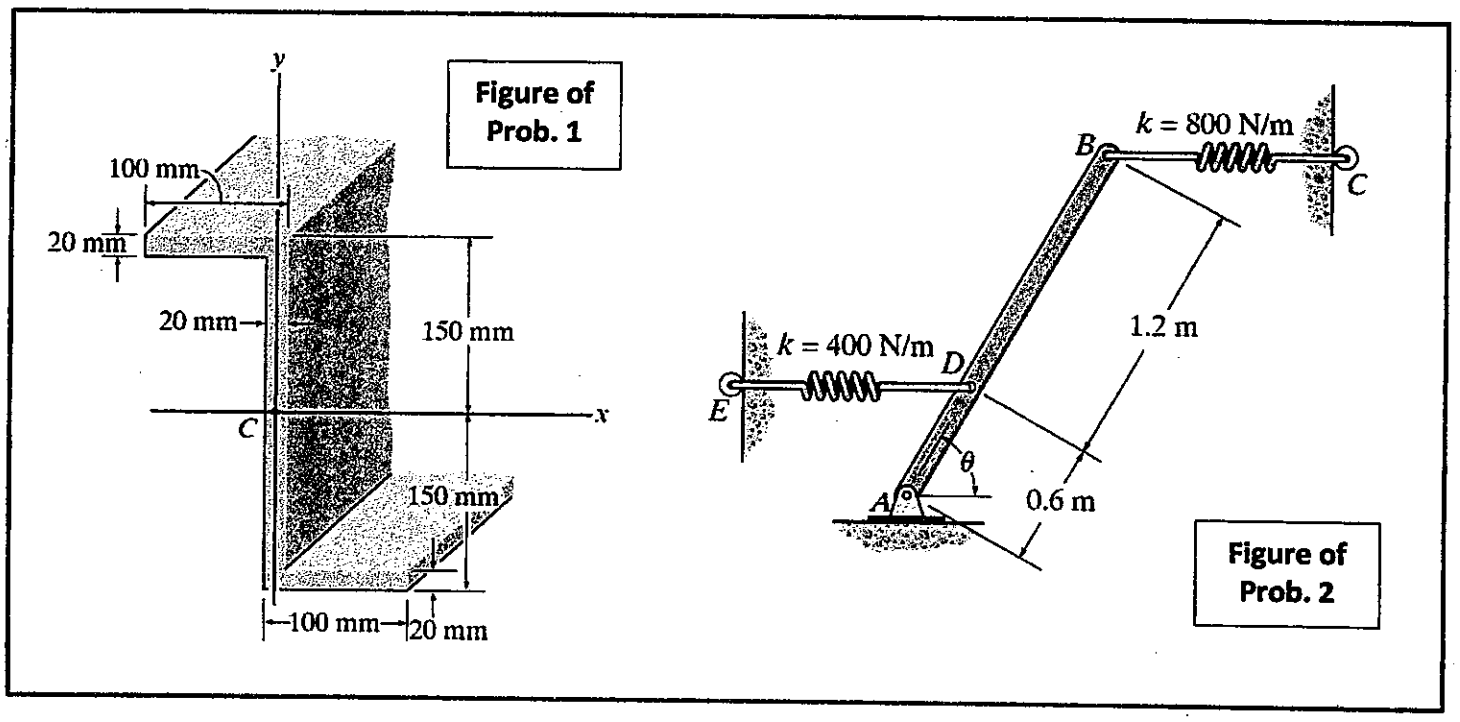
Note:

1. The solutions may not necessarily appear in order. Mark, however, the number of problems for your solutions clearly.
2. Examinees are responsible to present the problem numbers and answers clearly, cleanly, and precisely.
3. Examinees are responsible to present detailed derivations and calculations, otherwise will receive zero credit.

1. 25pts Consider a beam with the cross-sectional area shown in the figure, determine the orientation of the principal axes, which have their origin at centroid C of the beam's cross-sectional area, and find the corresponding maximum and minimum principal moments of inertia. *Write your final answer in the form:* $(\theta_{p1}, I_{max}, \theta_{p2}, I_{min})$ = (____ , ____ , ____ , ____) (5pts each) and show the principal axes (say, *u-v* axes) against the *x-y* axes in a draw (5pts).

2. 20pts The uniform bar *AB* weighs 500 N. If both springs *DE* and *BC* are unstretched when $\theta = 90°$, determine the angle θ for equilibrium and investigate the stability at the equilibrium position. *Write your final answer in the form:* θ = _____ , in stable or unstable equilibrium.

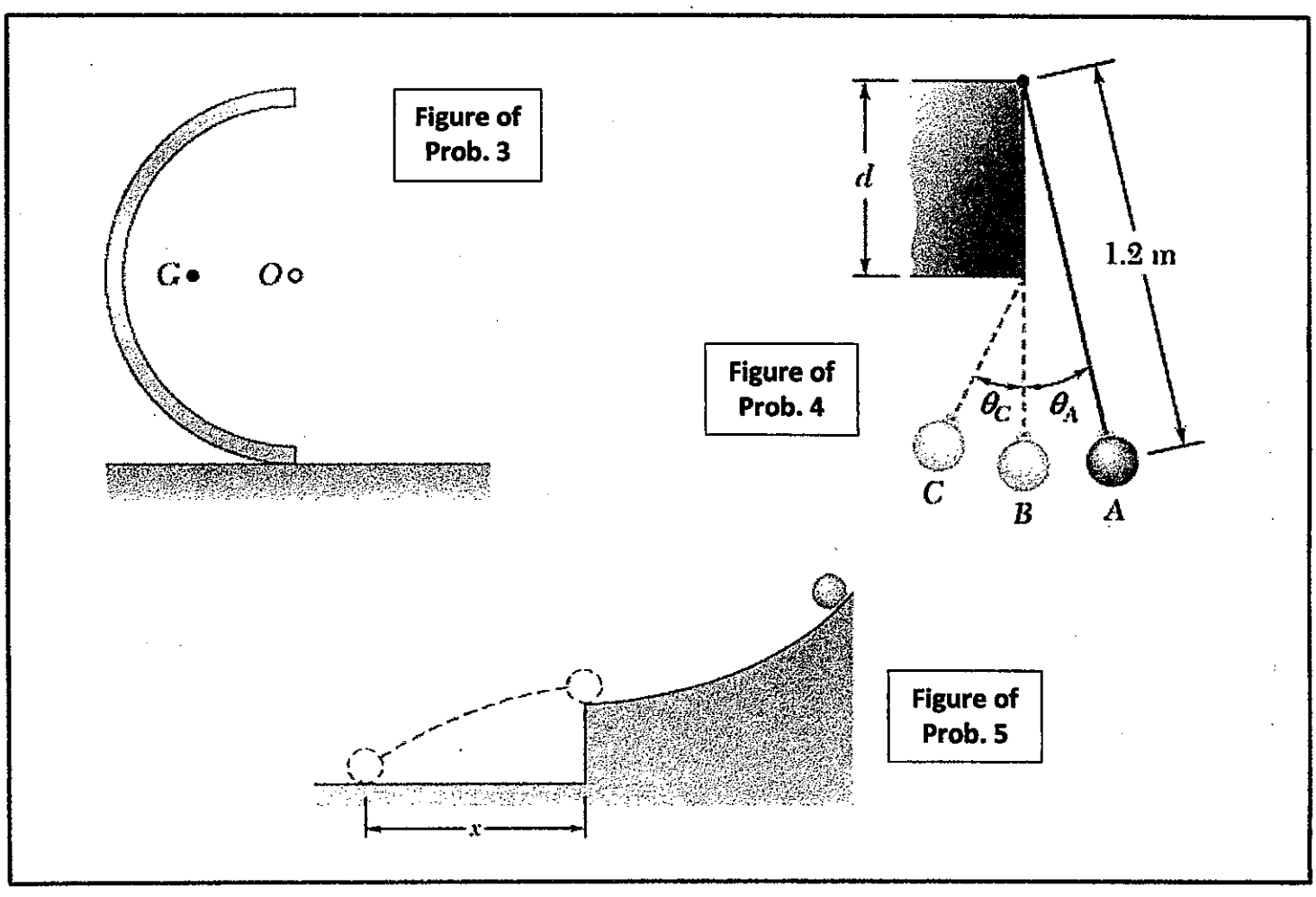


（請接背面）

3. **30pts** A half section of pipe of mass m and radius r is released from rest in the position shown. Knowing that the pipe rolls without sliding, determine **(a)** the distance $\overline{OG}$ (10pts), **(b)** its angular velocity after the pipe has rolled through 90° (10pts), **(c)** the reaction and its direction at the horizontal surface at the same instant. (10pts). *Write your final answer in the form:* **(a)** $\overline{OG} =$ _____ . **(b)** $\omega =$ _____ . **(c)** $(R_x, R_y) =$ (_____ , _____) .

4. **20pts** A small bob is attached to a cord of length 1.2 m and is released from rest when $\theta_A = 5°$. Knowing that $d = 0.6$ m, determine **(a)** the travel time required for the bob to return to Point A (10pts), and **(b)** the amplitude θ_C (10pts) where C is the highest position on the path BC. *Write your final answer in the form:* **(a)** $T =$ _____. **(b)** $\theta_C =$ _____.

5. **5pts** A round object of mass m and radius r is released from rest at the top of a curved surface and rolls without slipping until it leaves the surface with a horizontal velocity as shown. Will a solid sphere, a solid cylinder or a hoop travel the greatest distance c? (a) A solid sphere (b) A solid cylinder (c) A hoop (d) They will all travel the same distance. (*Must give explanation to support your answer.*)



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