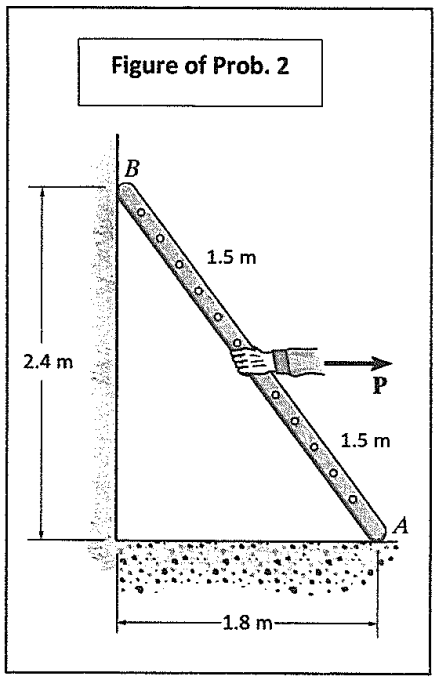
Note: Examinees are responsible of

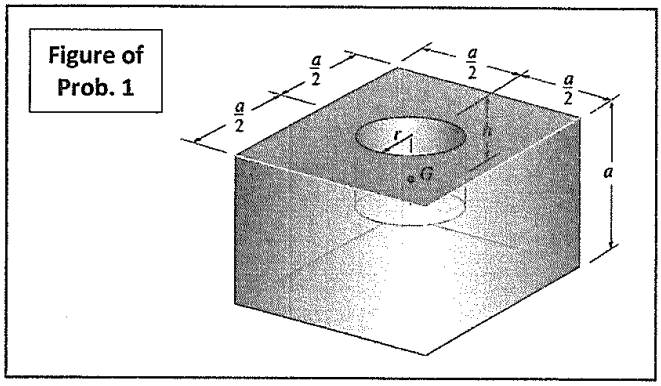
1. presenting the problem numbers and answers clearly, cleanly, and precisely. The solutions may not necessarily appear in order.
2. presenting detailed derivations and calculations, otherwise no credit will be granted.

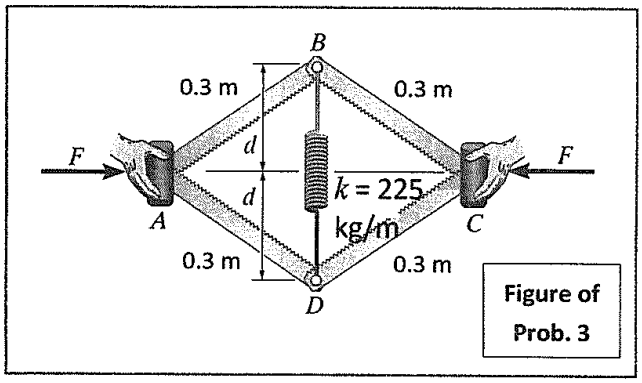
1. **15pts** A hole having a radius r is to be drilled in the center of the homogeneous block. Determine the depth h of the hole so that the center of gravity G is as low as possible. *Write your final answer in the form:* (h = _____).

2. **15pts** The uniform 20-kg ladder rests on the rough floor for which the coefficient of static friction is $\mu_s = 0.4$ and against the smooth wall at B. (a) Determine the horizontal force P the man must exert on the ladder in order to cause it to move. (b) Will the ladder remain in contact with the wall? *Write your final answer in the form:* (a) (P = _____) (10pts) ; (b) (**Yes** or **No**). Detailed explanation is required in order to receive full credit (5pts).

3. **20pts** If a force of $F = 22.5$ kg is applied to the pads at A and C, determine the smallest dimension d required for equilibrium if the spring has an unstretched length of 0.3 m. The elastic constant of the spring is $k = 225\ kg/m$. *Write your final answer in the form:* (d = _____).







4. **20pts** Two uniform rods *AB* and *CE*, each of mass 1.5 kg and length 600 mm, are welded to each other at their midpoints. Knowing that this assembly has an angular velocity of constant magnitude $\omega =$ 12 rad/s, determine the magnitude and direction of the angular momentum $\mathbf{H}_D = \mathrm{H}_D(\alpha\hat{\imath} + \beta\hat{\jmath} + \gamma\hat{k})$ of the assembly about *D*. *Write your final answer in the form:* ($\mathbf{H}_D$ = _____). (In vector form)

5. **25pts** Two slender rods, each of length *l* and mass *m*, are released from rest in the position shown. Knowing that a small knob at end *B* of rod *AB* bears on rod *CD*, determine immediately after release (a) the acceleration of end *C* of rod *CD*, (b) the force exerted on the knob. *Write your final answer in the form:* **((a)** a_C = _____ (15pts) ; **(b)** F_B = _____ (10pts) **).**

6. **5pts** A solid steel sphere *A* of radius *r* and mass *m* is released from rest and rolls without slipping down an incline as shown. After traveling a distance *d* the sphere has a speed *v*. If a solid steel sphere of radius 2*r* is released from rest on the same incline, what will its speed be after rolling a distance *d*?

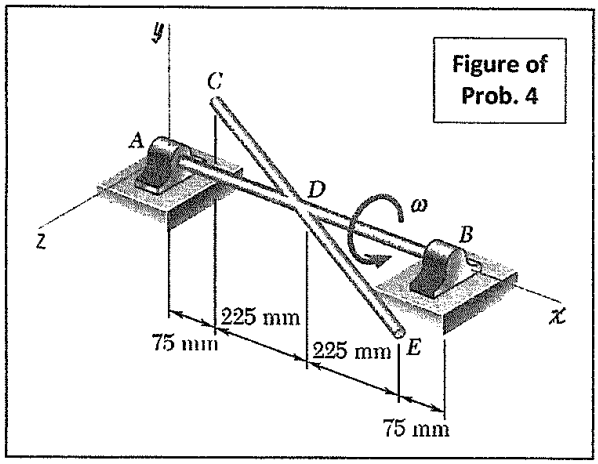


Figure of Prob. 4

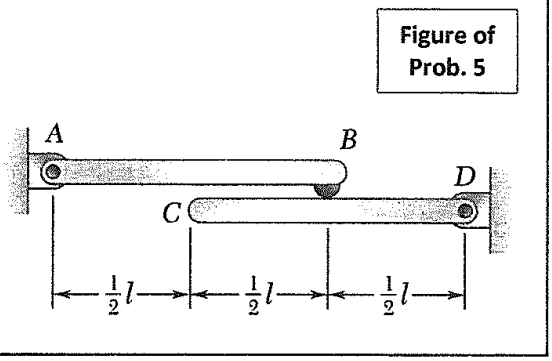


Figure of Prob. 5

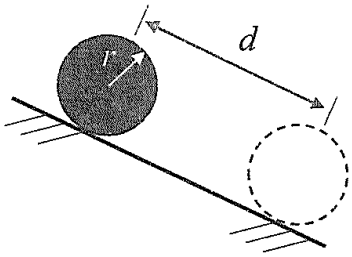


Figure of Prob. 6

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