

Problem 1. (25 Points) A small sphere **B** of mass m is released from rest in the position shown in **Figure 1** and swings freely in a vertical plane, first about **O** and then about the peg **A** after the cord comes in contact with the peg. Please determine the tension in the cord (a) just before the sphere comes in contact with the peg, (b) just after it comes in contact with the peg. In both cases, please draw the corresponding free-body diagram before making any computation. Without the free-body diagram, you will not be able to obtain any credits.

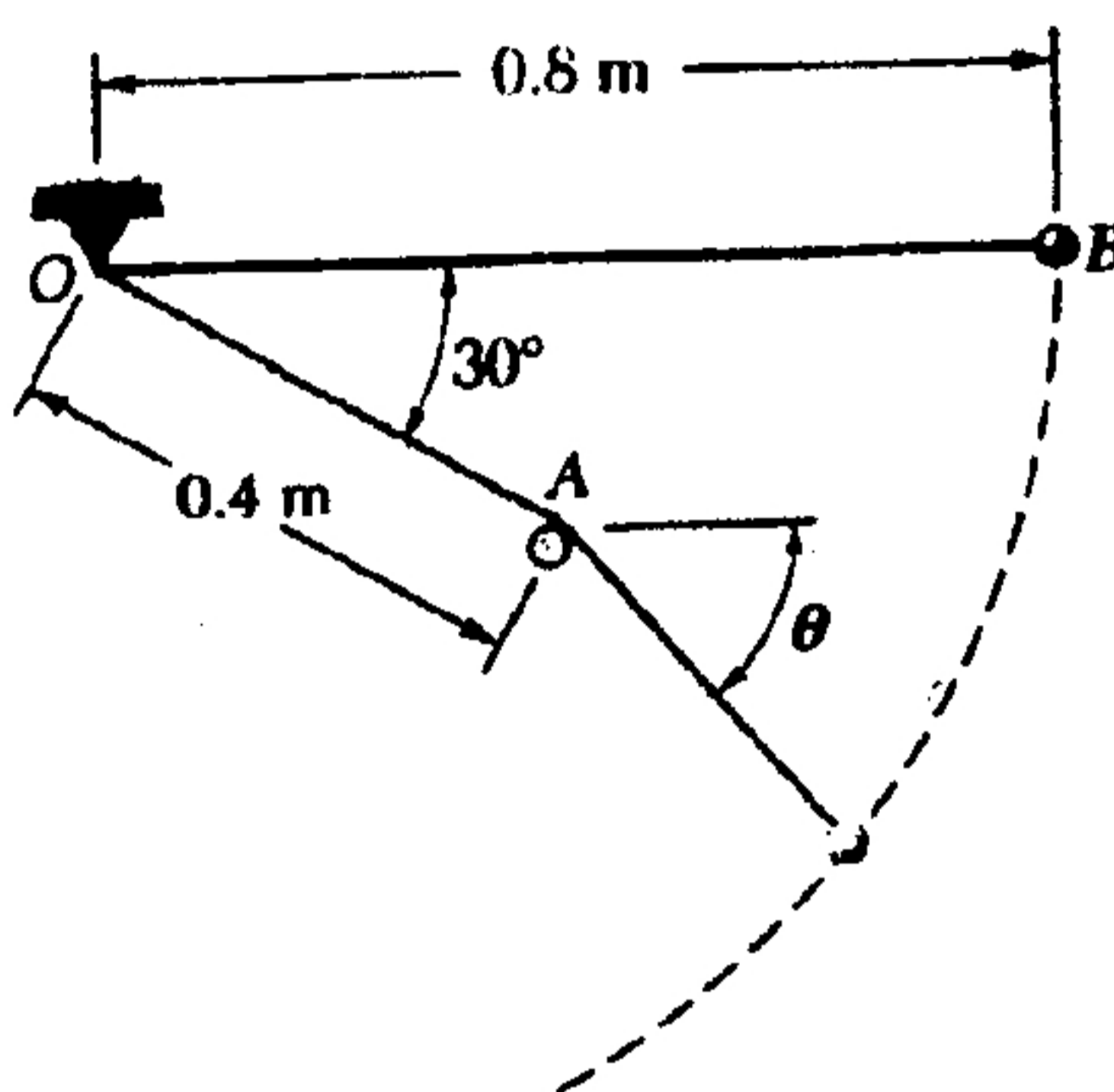


Figure 1

Problem 2. (25 Points) Consider the system shown in **Figure 2**.

1. Please explain the principle of virtual work. (5 Pts)
2. Is the system a conservative system? Why? (4 Pts)
3. Please define your own variable and express the kinetic energy and potential energy of this system (8 pts)
4. Please find the equation of motion and its natural frequency (8 pts)

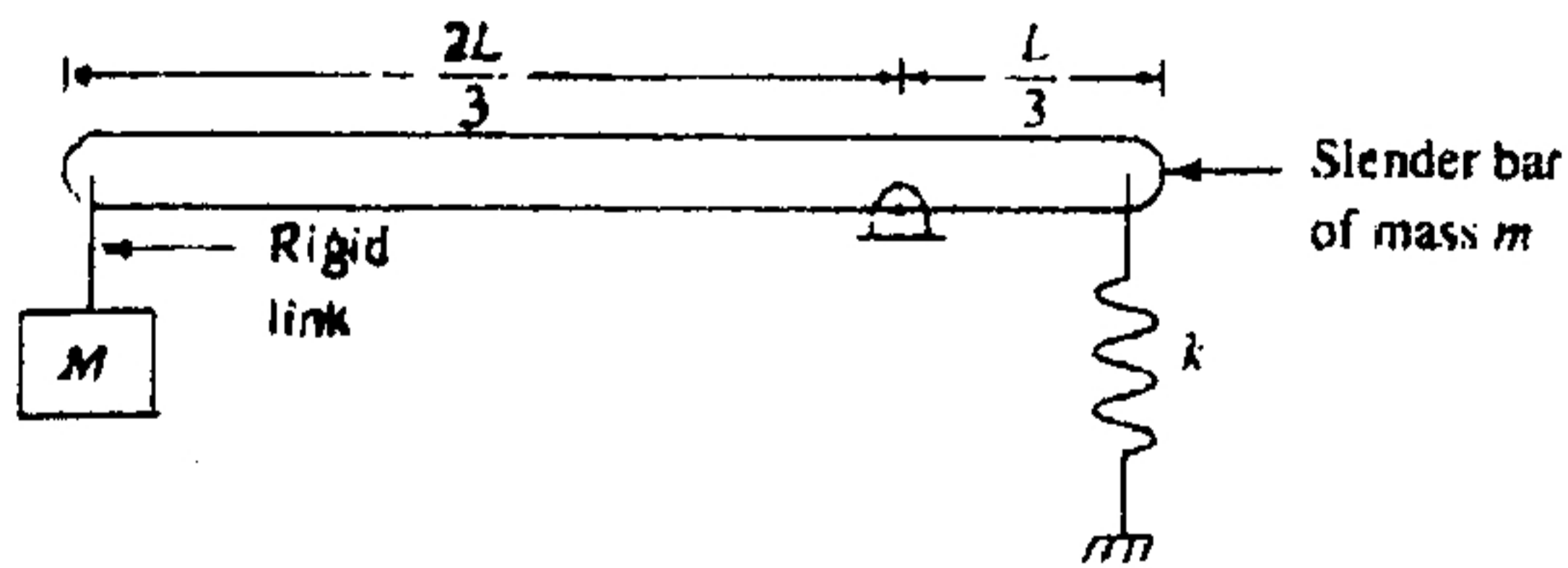


Figure 2

(背面仍有題目,請繼續作答)

本試題是否可以使用計算機： 可使用， 不可使用 (請命題老師勾選)

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Problem 3. (25 Points) As shown in Figure 3, a thin disc of radius $R= 4\text{ft}$ and weight 322 lb rotates at an angular speed ω_2 of 100 rad/s relative to a platform. The platform rotates with an angular speed ω_1 of 20 rad/s relative to the ground.

- (a) Please obtain the overall angular velocity of the thin disc. (5 Pts)
- (b) Please find the resulted moment (or torque). (10 Pts)
- (c) Please find the reaction force acted at bearings A and B. (10 Pts)

Neglect the mass of the shaft and assume that bearing A restrains the system in the radial direction. (i.e., 軸承 A 承受 x,y,z 方向之 reaction force, 而軸承 B 僅承受 x 與 z 方向之 reaction force.)

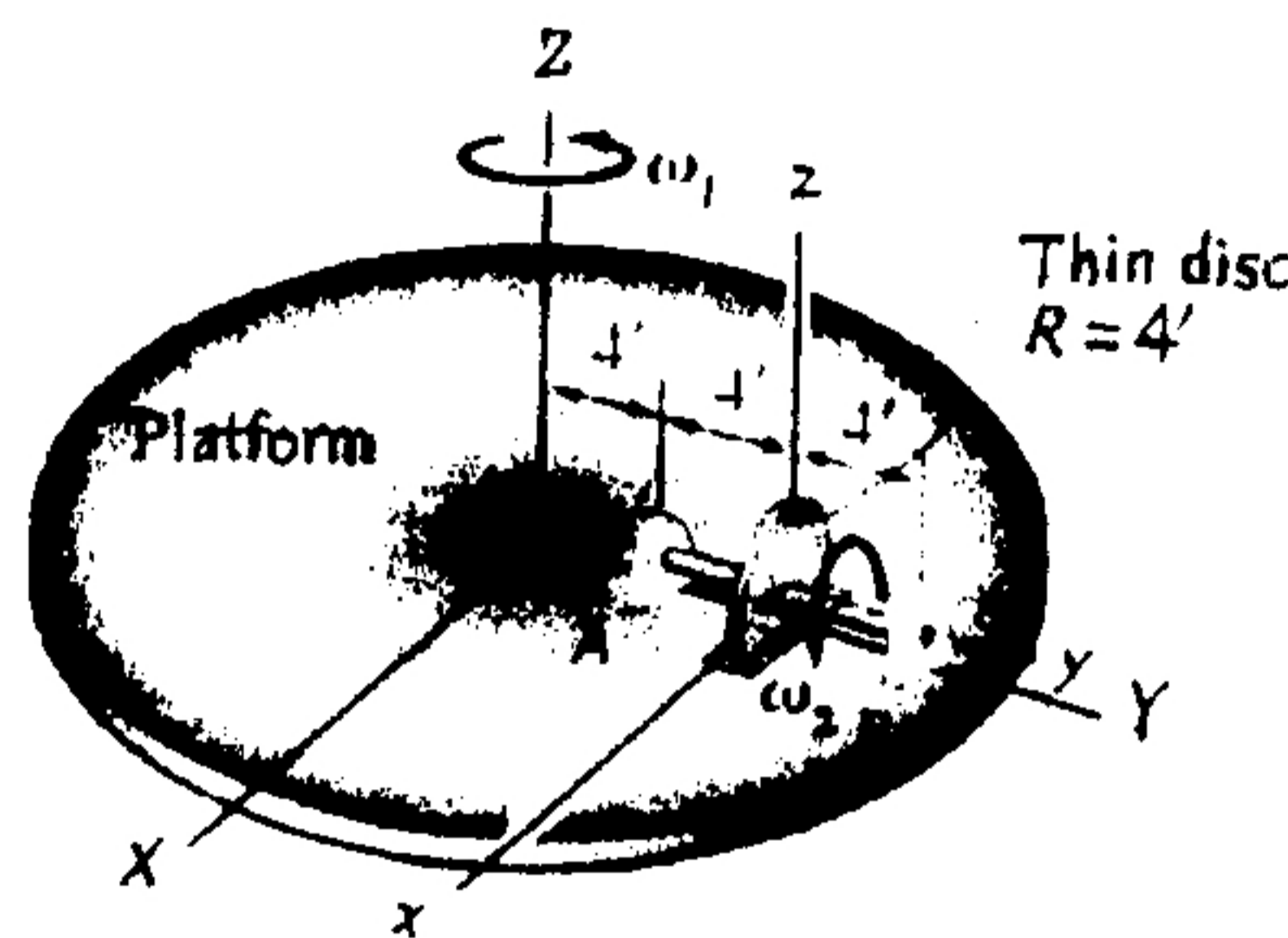


Figure 3

Problem 4. (25 Points) As shown in Figure 4, the 15-in. uniform rod BD weighs 8 lb and is connected as shown to crank AB and to a collar D of negligible weight, which can slide freely along a horizontal rod. Knowing that crank AB rotates counterclockwise at the constant rate of 300 rpm , please determine the reaction at D when $\theta=0^\circ$.

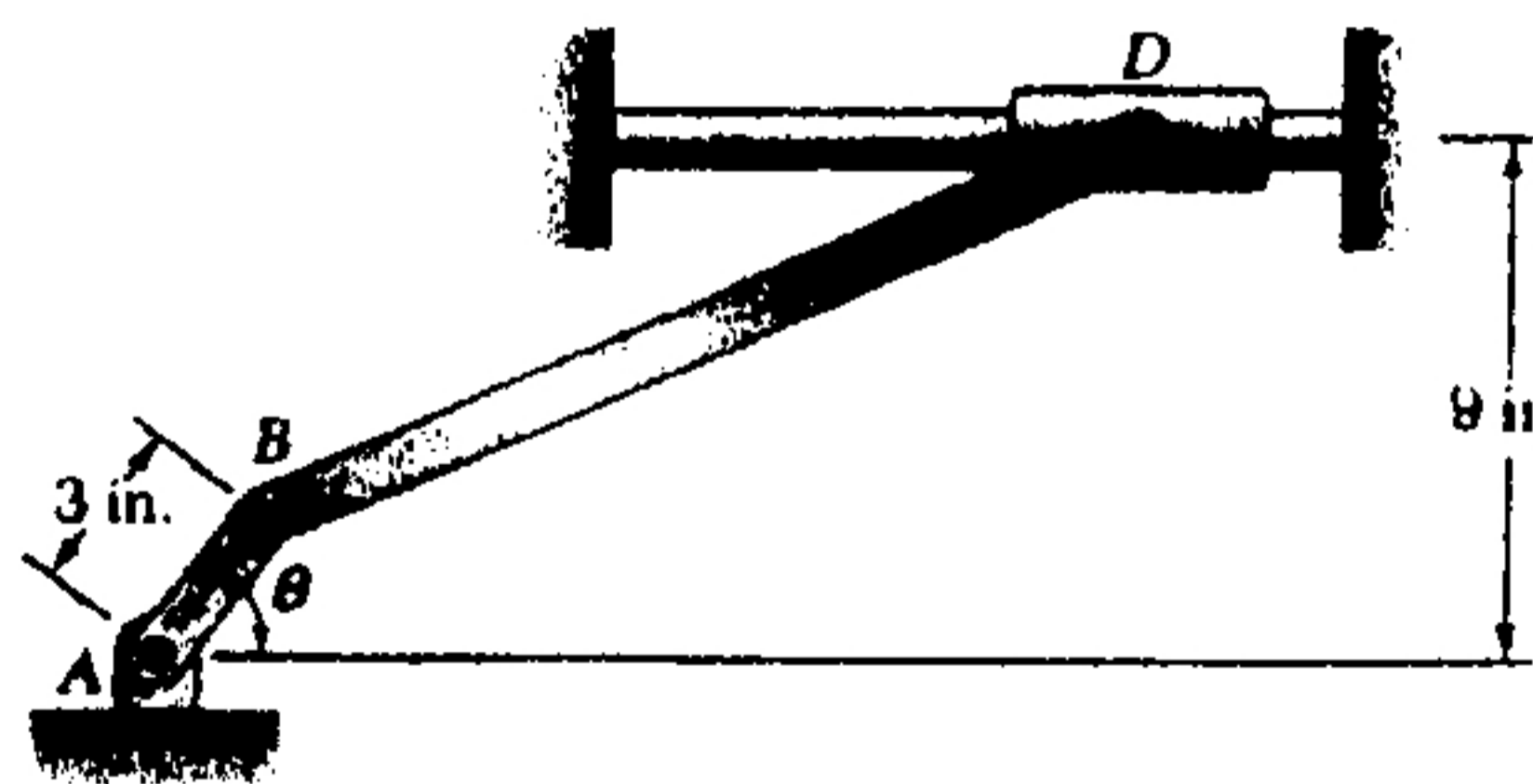


Figure 4