

1. [15 points] Define and describe the following terms:

(1) Equilibrium of a two-force member. (2) Statically indeterminacy. (3) Polar moment of inertia.

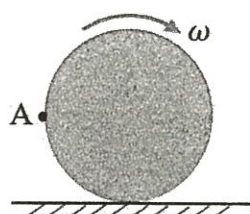
2. [15 points] Multiple-choice questions. Refer to the figures below.

(1) The ball rolls without slipping on the fixed surface as shown. What is the direction of the velocity of Point A?

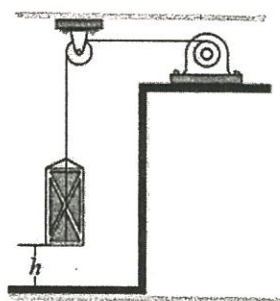
(a)  $\rightarrow$  (b)  $\nearrow$  (c)  $\downarrow$  (d)  $\searrow$

(2) A motor hoists a 50-kg crate at constant speed to a height of  $h = 6$  m in 3 s. If the indicated power of the motor is 4 kW, determine the motor's efficiency. (a)  $\epsilon = 0.736$  (73.6%) (b)  $\epsilon = 0.05$  (5.0%) (c)  $\epsilon = 0.245$  (24.5%) (d)  $\epsilon = 0.025$  (2.5%)

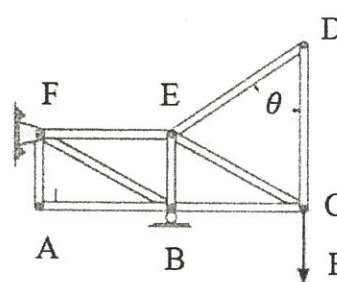
(3) How many zero-force members are in the right structure? (a) 0 (b) 2 (c) 3 (d) 4



Problem 2.1



Problem 2.2



Problem 2.3

3. [15 points] A  $5^\circ$  wedge is to be forced under a 1400-N machine base at A. Knowing that the coefficient of static friction at all surfaces is 0.20.

(1) Determine the force  $P$  required to move the wedge.

(2) Indicate whether the machine base will move.

4. [20 points] Blocks A and B have a mass of 20 kg and 10 kg, respectively.

(1) If no motion occurs, determine the greatest mass of block D. (15 points)

(2) If motion occurs, the relative motion happens first between A/B or A/C? (5 points)

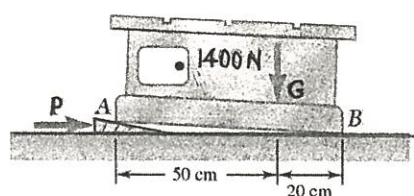
5. [15 points] The system shown is in equilibrium when  $\phi = 0^\circ$ .

(1) What is the spring length when it is unstretched?

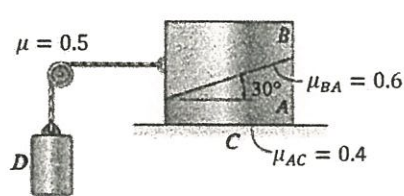
(2) What is the  $\delta_{spring}$  when  $\phi = 90^\circ$ ?

(3) If the initial  $\phi = 90^\circ$ , block C is given a slight nudge when the system is in that position. Determine the speed of the block as it passes through the equilibrium position  $\phi = 0$ . Neglect the weight of the rod.

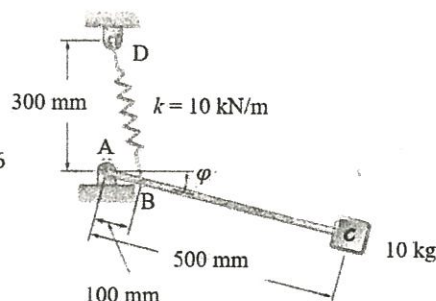
6. [20 points] At a given instant the slider block A is moving to the right with the motion shown. Determine the angular acceleration of link AB and the acceleration of point B at this instant.



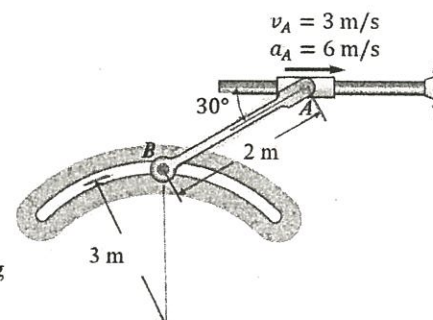
Problem 3



Problem 4



Problem 5



Problem 6