Practice Problem Set 1: Engineering Mechanics (NMEC101)
Rigid Bodies: Equivalent Systems of Forces

Instruction:
Figure numbers correspond to the problem numbers.

1. When the couple M is applied to the link in a mechanism, the resulting forces exerted on the link from a guide and the connecting links are as shown. Determine *(a)* the values of M and α so that the applied forces and couple can be reduced to a single equivalent force whose line of action passes through points *B* and *D*, *(b)* the equivalent force.
2. The three forces and a couple shown are applied to an angle bracket. *(a)* Find the resultant of this system of forces. *(b)* Locate the points where the line of action of the resultant intersects line *AB* and line *BC*.
3. Pulleys *A* and *B* are mounted on bracket *CDEF*. The tension on each side of the two belts is as shown. Replace the four forces with a single equivalent force, and determine where its line of action intersects the bottom edge of the bracket.
4. Three forces and a couple act on crank *ABC*. For P = 25 N and α = 40°, *(a)* determine the resultant of the given system of forces, *(b)* locate the point where the line of action of the resultant intersects a line drawn through point *B* and *C*. *(c)* locate the point where the line of action of the resultant intersects a line drawn through points *A* and *B*.
5. A piece of sheet metal is bent into the shape shown and is acted upon by three forces. Replace the three forces with an equivalent wrench and determine *(a)* the magnitude and direction of the resultant **R**, *(b)* the pitch of the wrench, *(c)* the point where the axis of the wrench intersects the *yz* plane.
6. A block of wood is acted upon by three forces of the same magnitude *P* and having the directions shown. Replace the three forces with an equivalent wrench and determine *(a)* the magnitude and direction of the resultant **R**, *(b)* the pitch of the wrench, *(c)* the point where the axis of the wrench intersects the *xy* plane.
7. In an automated manufacturing process, three holes are drilled simultaneously in an aluminum block as shown. Each drill exerts a 50-N force and a 0.100-N. m couple on the block. Knowing that drill *A* rotates counterclockwise and drills *B* and *C* rotate clockwise (as observed from each drill), reduce the forces and couples exerted by the drills on the block to an equivalent wrench and determine *(a)* the resultant force **R**, *(b)* the pitch of the wrench, *(c)* the point where the wrench intersects the *xz* plane.
8. Two bolts *A* and *B* are tightened by applying the forces and couple shown. Replace the two wrenches with a single equivalent wrench and determine *(a)* the resultant **R**, *(b)* the pitch of the single equivalent wrench, *(c)* the point where the axis of the wrench intersects the *xz* plane.
9. A flagpole is guyed by three cables. If the tensions in the cables have the same magnitude *P*, replace the forces exerted on the pole with an equivalent wrench and determine *(a)* the resultant force **R**, *(b)* the pitch of the wrench, *(c)* the point where the axis of the wrench intersects the *xz* plane.

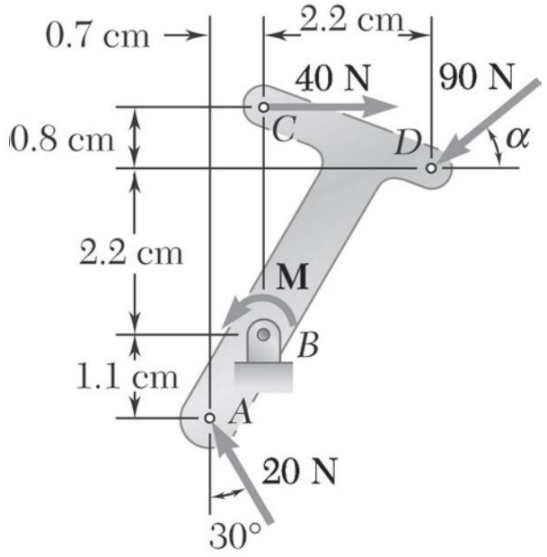

Fig. 1

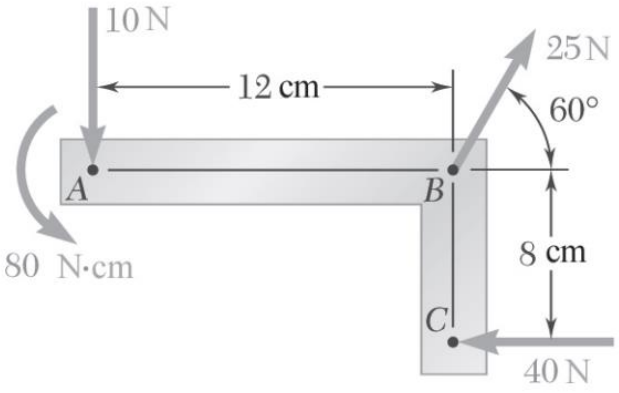

Fig. 2

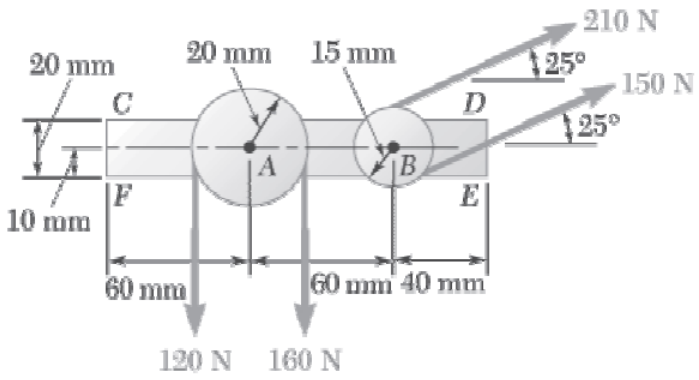

Fig. 3

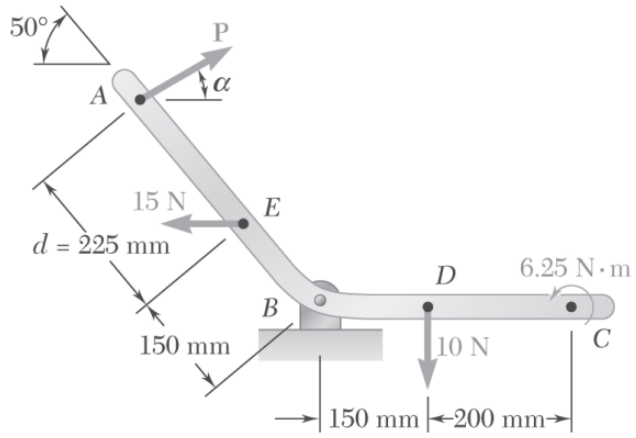

Fig. 4

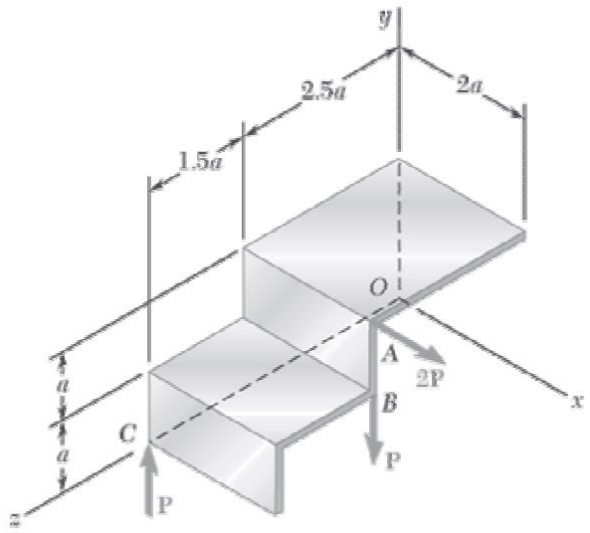

Fig. 5

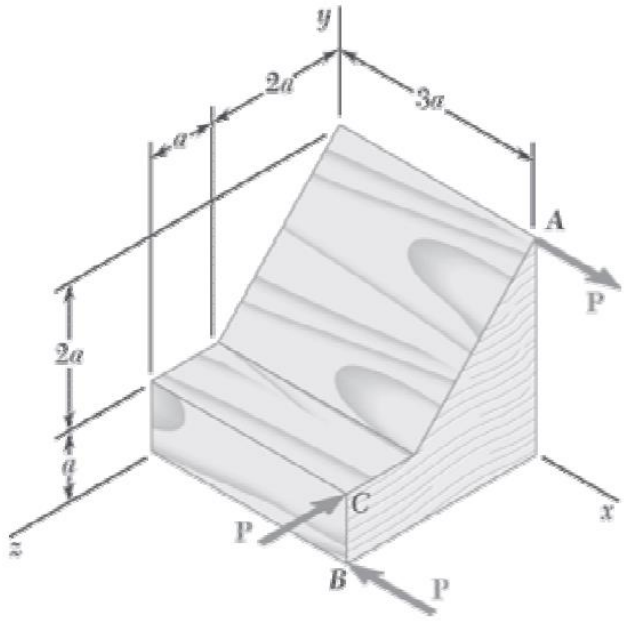

Fig. 6

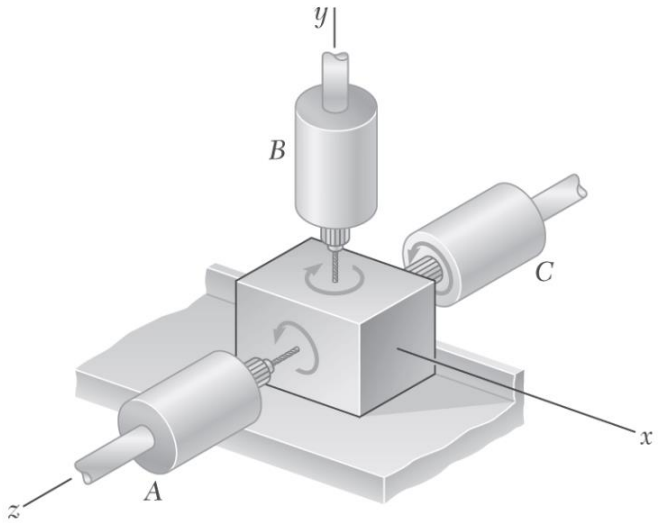
y
B
C
x
z
A

Fig. 7

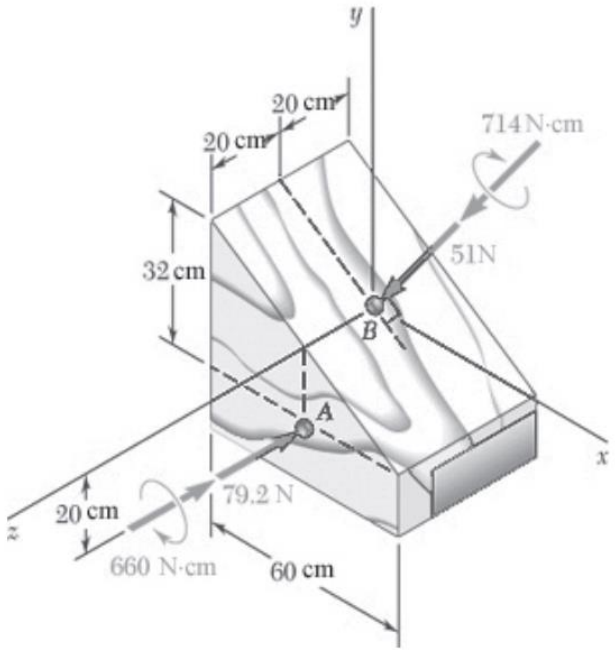
y
20 cm
20 cm
714 N·cm
51N
32 cm
B
A
x
z
20 cm
79.2 N
660 N·cm
60 cm

Fig. 8