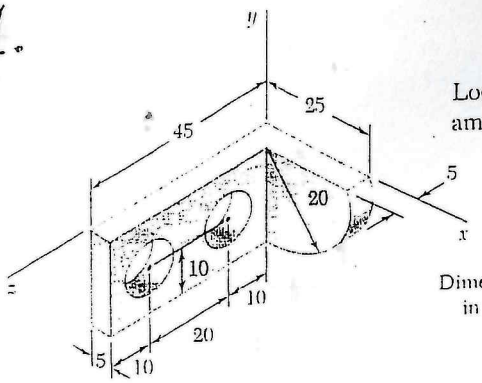
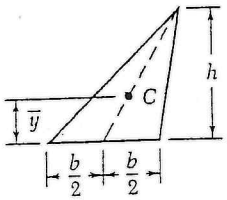
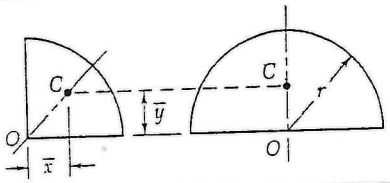
1.



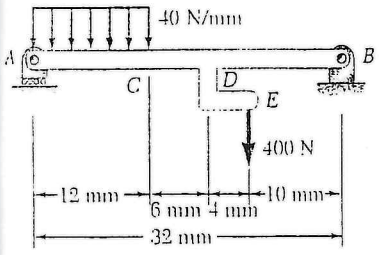

Dimensions in mm

Locate the center of gravity of the steel machine element shown. The diameter of each hole is 10 mm. ( 20 % )

Centroids of Common Shapes of Areas and Lines

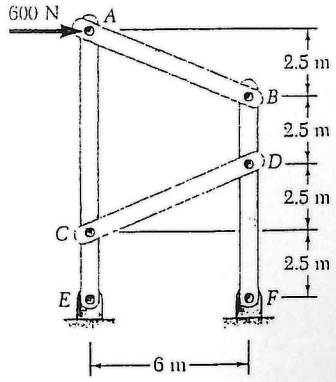
| Shape | | $\bar{x}$ | $\bar{y}$ | Area |
|---|---|---|---|---|
| Triangular area |  | | $\frac{h}{3}$ | $\frac{bh}{2}$ |
| Quarter-circular area |  | $\frac{4r}{3\pi}$ | $\frac{4r}{3\pi}$ | $\frac{\pi r^2}{4}$ |
| Semicircular area | | 0 | $\frac{4r}{3\pi}$ | $\frac{\pi r^2}{2}$ |

2.




Draw the shear and bending-moment diagrams for the mechanical link *AB*. The distributed load of 40 N/mm extends over 12 mm of the beam, from *A* to *C*, and the 400 N load is applied at *E*. ( 20 % )

3.




A 600 N horizontal force is applied to pin *A* of the frame shown. Determine the forces acting on the two vertical members of the frame. ( 20 % )

4.

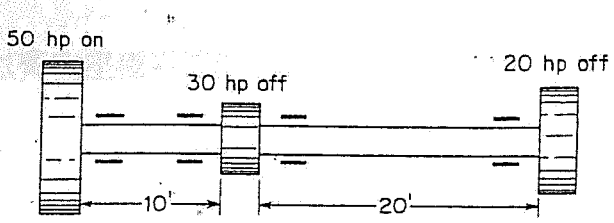



FIG. 4

The solid line shaft shown in Fig. 4 is made of steel, has diameter $d$ = 1.5 in., and runs at 525 rpm. It is supported in bearings so placed that bending of the shaft will be negligible. A driving belt feeds 50 hp to the left hand pulley while 30 hp and 20 hp, respectively, are taken off by belts overrunning the middle and right hand pulleys. Compute the maximum shear stress $\tau$ induced in the shaft and the total angle of twist $\phi$. Assume $G = 12(10)^6$ psi. (20%)

5.

A stepped solid circular shaft is built-in at its ends and subjected to an externally applied torque $T_0$ at the shoulder as shown in Fig. 5 Determine the angle of rotation $\phi_0$ of the shoulder section where $T_0$ is applied. (20%)

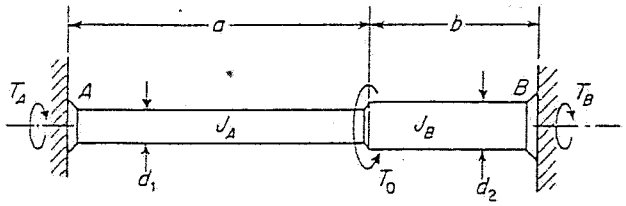



FIG. 5