The indicated force–couple system is applied to a small shaft at the center of the plate. Replace this system by a single force and specify the coordinate of the point on the x-axis through which the line of action of this resultant force passes.
The upper hinge $A$ of the uniform cabinet door has malfunctioned, causing the entire weight $mg$ of the 5-kg door to be carried by the lower hinge $B$. Determine the couple associated with these two forces. You may neglect the slight offset from the edge of the cabinet door to the hinge centerline.
2/73 An overhead view of the handlebars on an all-terrain vehicle is shown. If the indicated forces have a magnitude of \( F = 150 \text{ N} \), determine the moment created by the two forces about the vertical steering axis through point \( O \). Both \( n \)-axes are perpendicular to the left handlebar. Treat the problem as two-dimensional.
The force $F$ is applied to the leg-extension exercise machine as shown. Determine the equivalent force–couple system at point $O$. Use values of $F = 520 \text{ N}$, $b = 450 \text{ mm}$, $h = 215 \text{ mm}$, $r = 325 \text{ mm}$, $\theta = 15^\circ$, and $\phi = 10^\circ$. 

Problem 2/74
The device shown is a part of an automobile seat-back-release mechanism. The part is subjected to the 4-N force exerted at A and a 300-N·mm restoring moment exerted by a hidden torsional spring. Determine the y-intercept of the line of action of the single equivalent force.
PROBLEMS

2/81 Replace the three horizontal forces and applied couple with an equivalent force–couple system at $O$ by specifying the resultant $\mathbf{R}$ and couple $M_O$. Next, determine the equation for the line of action of the stand-alone resultant force $\mathbf{R}$.

Problem 2/81
If the resultant of the forces shown passes through point \( A \), determine the magnitude of the unknown tension \( T_2 \) which acts on the braked pulley.
2/91 Replace the three forces which act on the bent bar by a force–couple system at the support point A. Then determine the x-intercept of the line of action of the stand-alone resultant force \( R \).

![Diagram of the bent bar with forces and dimensions](image-url)
Uneven terrain conditions cause the left front wheel of the all-wheel-drive vehicle to lose traction with the ground. If the driver causes the traction forces shown to be generated by the other three wheels while his two friends exert the indicated forces on the vehicle periphery at points $E$ and $F$, determine the resultant of this system and the $x$- and $y$-intercepts of its line of action. Note that the front and rear tracks of the vehicle are equivalent; that is, $AD = BC$. Treat this as a two-dimensional problem and realize that $G$ lies on the car centerline.
PROBLEMS

2/95 Replace the three cable tensions acting on the upper portion of the compound bow with an equivalent force–couple system at $O$.

Problems 2/95
2/99 As part of a design test, the camshaft-drive sprocket is fixed, and then the two forces shown are applied to a length of belt wrapped around the sprocket. Find the resultant of this system of two forces and determine where its line of action intersects both the x- and y-axes.
2/124 The steel H-beam is being designed as a column to support the two vertical forces shown. Replace these forces by a single equivalent force along the vertical centerline of the column and a couple M.
PROBLEMS

2/125 The steel H-beam is being designed as a column to support the two vertical forces shown. Replace these forces by a single equivalent force along the vertical centerline of the column and a couple $\mathbf{M}$.
2/138 A 50-N horizontal force is applied to the handle of the industrial water valve as shown. The force is perpendicular to the vertical plane containing line OA of the handle. Determine the equivalent force–couple system at point O.
The threading die is screwed onto the end of the fixed pipe, which is bent through an angle of 20°. Replace the two forces by an equivalent force at O and a couple \( \mathbf{M} \). Find \( \mathbf{M} \) and calculate the magnitude \( M' \) of the moment which tends to screw the pipe into the fixed block about its angled axis through \( O \).
A basketball player applies a force $F = 275\, \text{N}$ to the rim at $A$. Determine the equivalent force–couple system at point $B$, which is at the center of the rim mounting bracket on the backboard.
An oil tanker moves away from its docked position under the action of reverse thrust from screw A, forward thrust from screw B, and side thrust from the bow thruster C. Determine the equivalent force–couple system at the mass center G.
PROBLEMS

2/154 The two forces and one couple act on the elements of a drill press as shown. Determine the equivalent force–couple system at point $O$. 

![Diagram of a drill press with forces and moments indicated.]
2/158 The pulley and gear are subjected to the loads shown. For these forces, determine the equivalent force–couple system at point $O$. 

![Diagram of the pulley and gear system with forces applied.](image)

**Problem 2/158**
The commercial airliner of Prob. 2/90 is redrawn here with three-dimensional information supplied. If engine 3 suddenly fails, determine the resultant of the three remaining engine thrust vectors, each of which has a magnitude of 90 kN. Specify the \( y \)- and \( z \)-coordinates of the point through which the line of action of the resultant passes. This information would be critical to the design criteria of performance with engine failure.
2/162 The floor exerts the four indicated forces on the wheels of an engine hoist. Determine the location in the x-y plane at which the resultant of the forces acts.

Dimensions in millimeters

Problem 2/162
2/164 Replace the two forces and one couple acting on the rigid pipe frame by their equivalent resultant force \( \mathbf{R} \) acting at point \( O \) and a couple \( \mathbf{M}_O \).
2/167 Replace the two forces which act on the pneumatic-hose reel by an equivalent force–couple system at $O$. The 20-N force which results from the weight of excess hose being wound up lies in a plane parallel to the $y$-$z$ plane and loses contact with the hose reel at a radius of 160 mm.
Reduce the system of two forces and two couples to point E as a resultant force and a resultant couple. Then reduce the system to a wrench. State whether the wrench is positive or negative. Also determine the coordinates of the point where the wrench cuts through the yz plane.

\( F_1 = 36 \text{ N} \) (\( G \) is the midpoint of line \( AE \))

\( F_2 = 26 \text{ N} \) (within plane \( yz \))

\( M_1 = 44 \text{ Nm} \) (within plane \( ABC \))

\( M_2 = 96 \text{ Nm} \) (within plane \( ADE \))