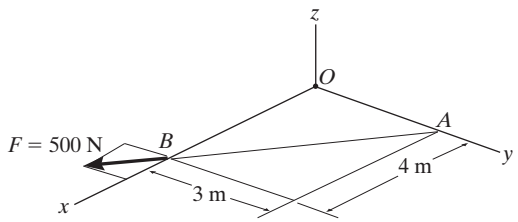
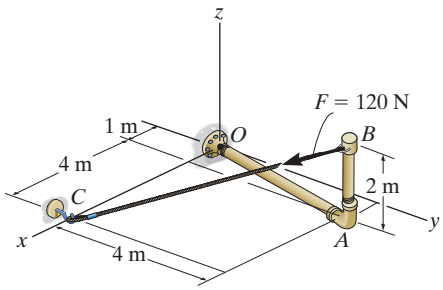
FUNDAMENTAL PROBLEMS

F4–10. Determine the moment of force **F** about point *O*. Express the result as a Cartesian vector.



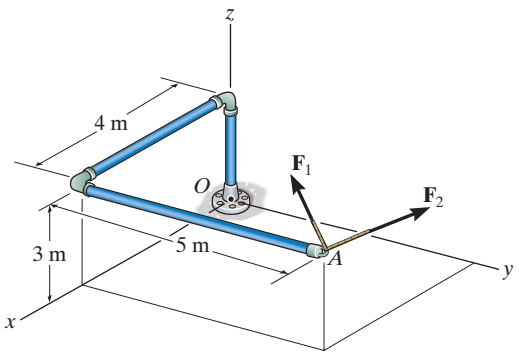
Prob. F4–10

F4–11. Determine the moment of force **F** about point *O*. Express the result as a Cartesian vector.



Prob. F4–11

F4–12. If $\mathbf{F}_1 = \{100\mathbf{i} - 120\mathbf{j} + 75\mathbf{k}\}$ N and $\mathbf{F}_2 = \{-200\mathbf{i} + 250\mathbf{j} + 100\mathbf{k}\}$ N, determine the resultant moment produced by these forces about point *O*. Express the result as a Cartesian vector.

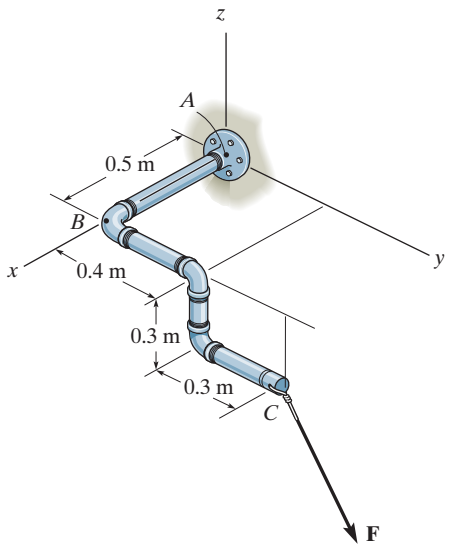


Prob. F4–12

PROBLEMS

4–22. The pipe assembly is subjected to the force of $\mathbf{F} = \{600\mathbf{i} + 800\mathbf{j} - 500\mathbf{k}\}$ N. Determine the moment of this force about point *A*.

4–23. The pipe assembly is subjected to the force of $\mathbf{F} = \{600\mathbf{i} + 800\mathbf{j} - 500\mathbf{k}\}$ N. Determine the moment of this force about point *B*.



Probs. 4–22/23

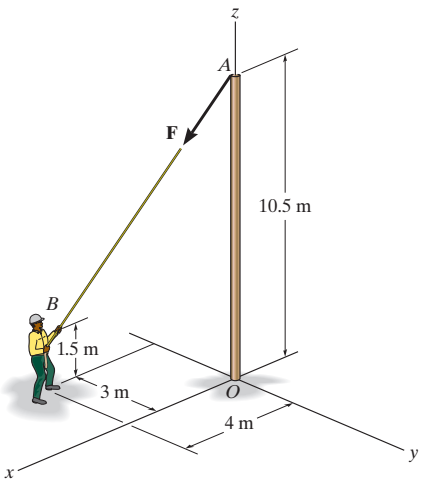
***4–24.** If **A**, **B**, and **D** are given vectors, prove the distributive law for the vector cross product, i.e., $\mathbf{A} \times (\mathbf{B} + \mathbf{D}) = (\mathbf{A} \times \mathbf{B}) + (\mathbf{A} \times \mathbf{D})$.

4–25. Prove the triple scalar product identity $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C}) = (\mathbf{A} \times \mathbf{B}) \cdot \mathbf{C}$.

4–26. Given the three nonzero vectors **A**, **B**, and **C**, show that if $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C}) = 0$, the three vectors *must* lie in the same plane.

4–27. The man pulls on the rope with a force of $F = 20$ N. Determine the moment of this force about the base of the pole at O. Solve the problem two ways, i.e., by using a position vector from O to A, then O to B.

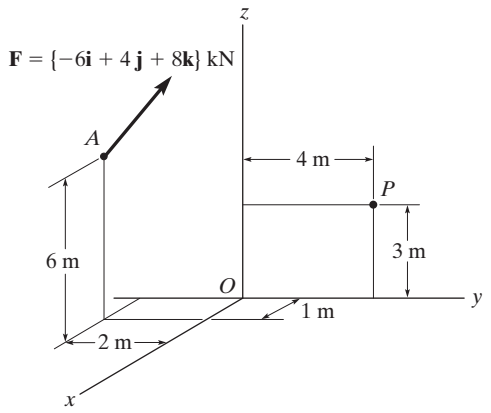
***4–28.** Determine the smallest force F that must be applied to the rope in order to create a moment of $M = 900\ \text{N}\cdot\text{m}$ at point O.



Probs. 4–27/28

4–29. Determine the moment of the force **F** about point O. Express the result as a Cartesian vector.

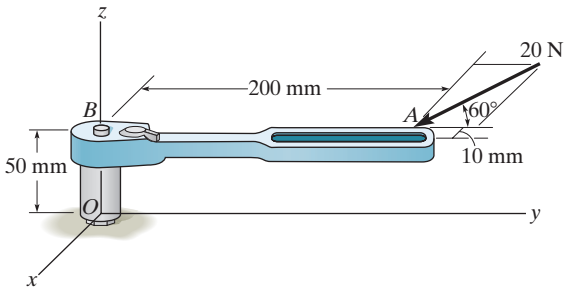
4–30. Determine the moment of the force **F** about point P. Express the result as a Cartesian vector.



Probs. 4–29/30

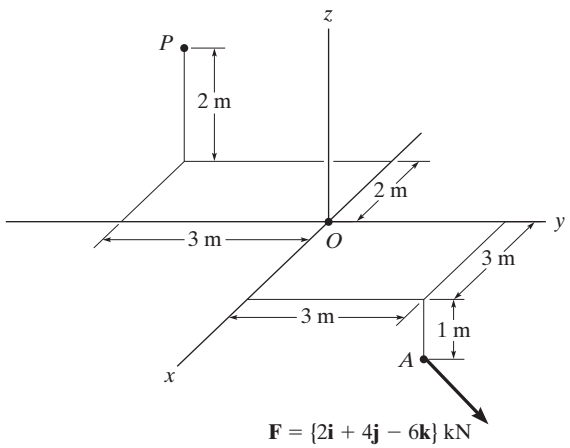
4–31. The 20-N horizontal force acts on the handle of the socket wrench. What is the moment of this force about point B. Specify the coordinate direction angles α, β, γ of the moment axis.

***4–32.** The 20-N horizontal force acts on the handle of the socket wrench. Determine the moment of this force about point O. Specify the coordinate direction angles α, β, γ of the moment axis.



Probs. 4–31/32

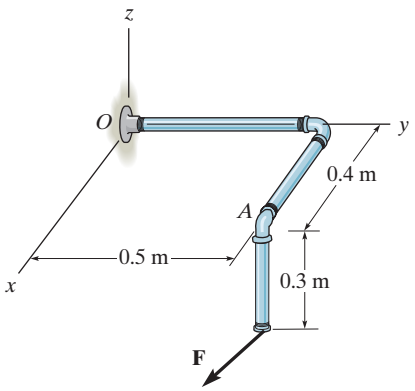
4–33. Determine the moment of the force **F** about point P. Express the result as a Cartesian vector.



Prob. 4–33

4–34. Determine the coordinate direction angles α, β, γ of force **F**, so that the moment of **F** about O is zero.

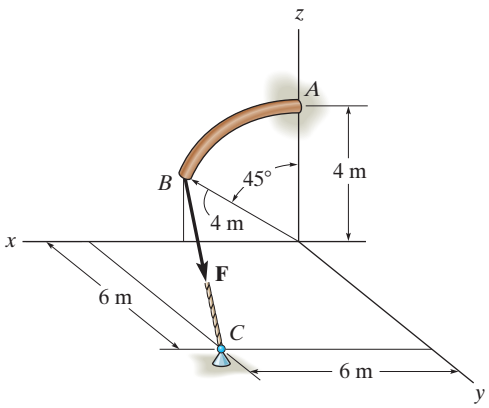
4–35. Determine the moment of force **F** about point O. The force has a magnitude of 800 N and coordinate direction angles of $\alpha = 60°$, $\beta = 120°$, $\gamma = 45°$. Express the result as a Cartesian vector.



Probs. 4–34/35

***4–36.** Determine the moment of the force of $F = 600$ N about point A.

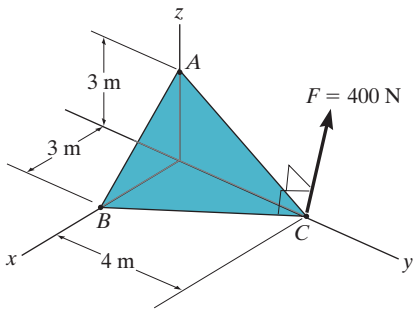
4–37. Determine the smallest force F that must be applied along the rope in order to develop a moment of $M = 1500\ \text{N} \cdot \text{m}$ at A.



Probs. 4–36/37

4–38. Force **F** acts perpendicular to the inclined plane. Determine the moment produced by **F** about point A. Express the result as a Cartesian vector.

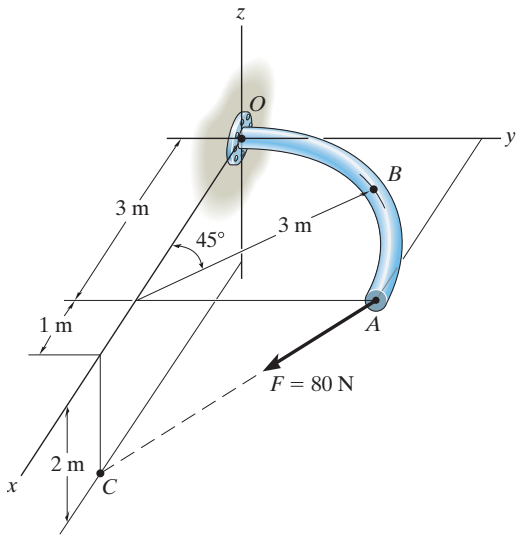
4–39. Force **F** acts perpendicular to the inclined plane. Determine the moment produced by **F** about point B. Express the result as a Cartesian vector.



Probs. 4–38/39

***4–40.** The curved rod lies in the x–y plane and has a radius of 3 m. If a force of $F = 80$ N acts at its end as shown, determine the moment of this force about point O.

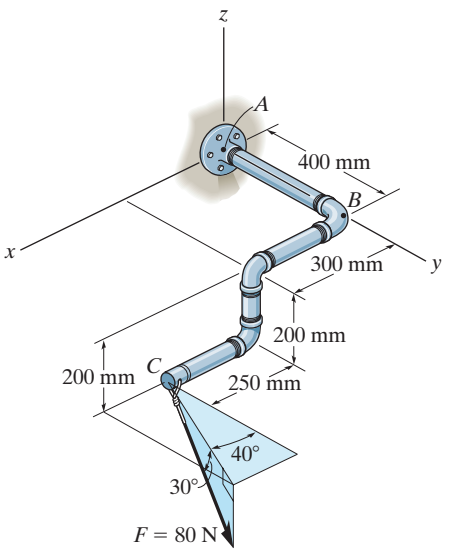
4–41. The curved rod lies in the x–y plane and has a radius of 3 m. If a force of $F = 80$ N acts at its end as shown, determine the moment of this force about point B.



Probs. 4–40/41

4–42. The pipe assembly is subjected to the 80-N force. Determine the moment of this force about point *A*.

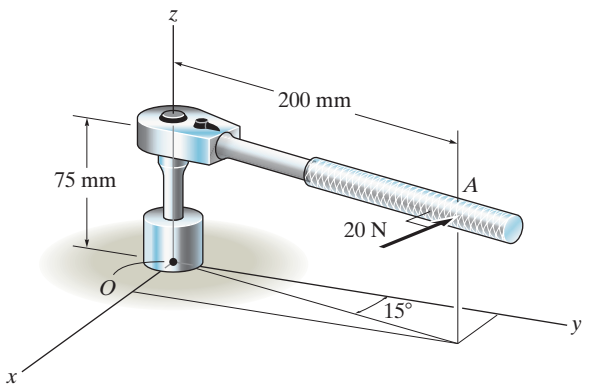
4–43. The pipe assembly is subjected to the 80-N force. Determine the moment of this force about point *B*.



Probs. 4–42/43

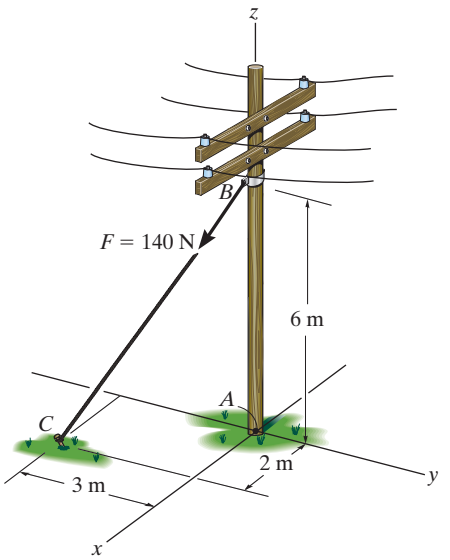
*4

***4–44.** A 20-N horizontal force is applied perpendicular to the handle of the socket wrench. Determine the magnitude and the coordinate direction angles of the moment created by this force about point *O*.



Prob. 4–44

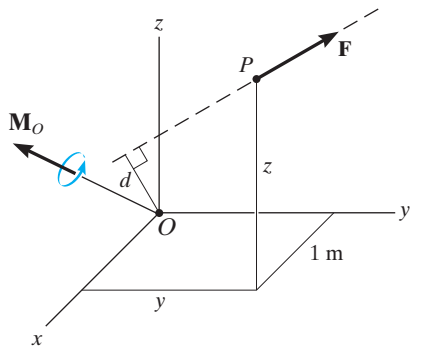
4–45. The cable exerts a 140-N force on the telephone pole. Determine the moment of this force about point *A*. Solve the problem using two different position vectors.



Prob. 4–45

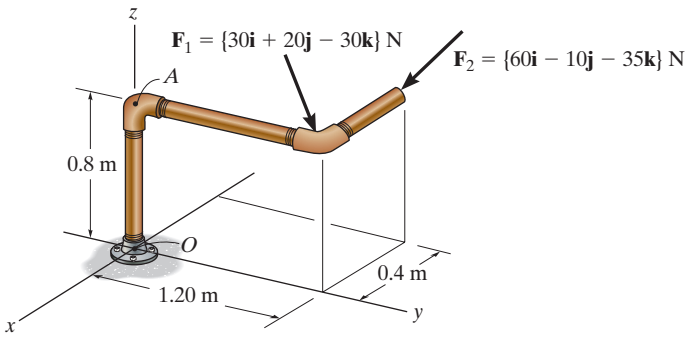
4–46. A force of $\mathbf{F} = \{6\mathbf{i} - 2\mathbf{j} + 1\mathbf{k}\}$ kN produces a moment of $\mathbf{M}_O = \{4\mathbf{i} + 5\mathbf{j} - 14\mathbf{k}\}$ kN · m about the origin, point *O*. If the force acts at a point having an *x* coordinate of $x = 1$ m, determine the *y* and *z* coordinates. *Note:* The figure shows **F** and $\mathbf{M}_O$ in an arbitrary position.

4–47. The force $\mathbf{F} = \{6\mathbf{i} + 8\mathbf{j} + 10\mathbf{k}\}$ N creates a moment about point *O* of $\mathbf{M}_O = \{-14\mathbf{i} + 8\mathbf{j} + 2\mathbf{k}\}$ N · m. If the force passes through a point having an *x* coordinate of 1 m, determine the *y* and *z* coordinates of the point. Also, realizing that $M_O = Fd$, determine the perpendicular distance *d* from point *O* to the line of action of **F**. *Note:* The figure shows **F** and $\mathbf{M}_O$ in an arbitrary position.



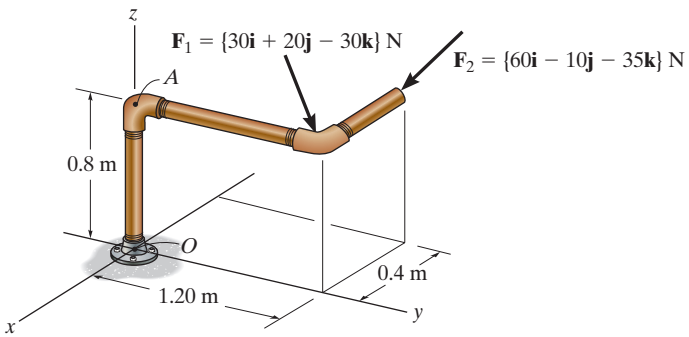
Probs. 4–46/47

***4–48.** Determine the moment of each force about point A. Add these moments and calculate the magnitude and coordinate direction angles of the resultant moment.



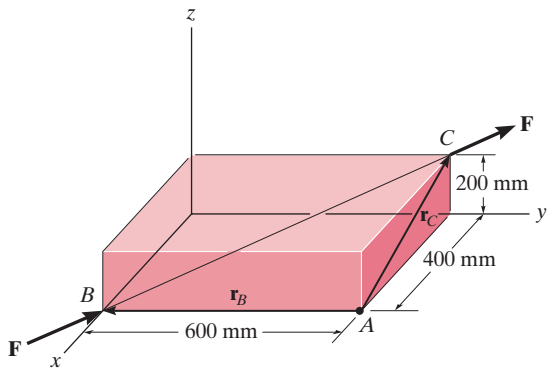
Prob. 4–48

4–49. Determine the moment about point O of each force acting on the pipe assembly. Add these moments and calculate the magnitude and coordinate direction angles of the resultant moment.



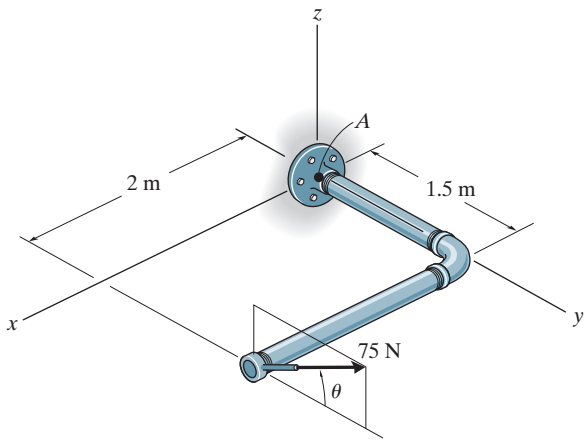
Prob. 4–49

4–50. A force $\mathbf{F}$ having a magnitude of $F = 100$ N acts along the diagonal of the parallelepiped. Determine the moment of $\mathbf{F}$ about the point A, using $\mathbf{M}_A = \mathbf{r}_B \times \mathbf{F}$ and $\mathbf{M}_A = \mathbf{r}_C \times \mathbf{F}$.



Prob. 4–50

■ **4–51.** Using a ring collar the 75-N force can act in the vertical plane at various angles θ. Determine the magnitude of the moment it produces about point A, plot the results of M (ordinate) versus θ (abscissa) for $0° \leq \theta \leq 180°$, and specify the angles that give the maximum and minimum moment.



Prob. 4–51