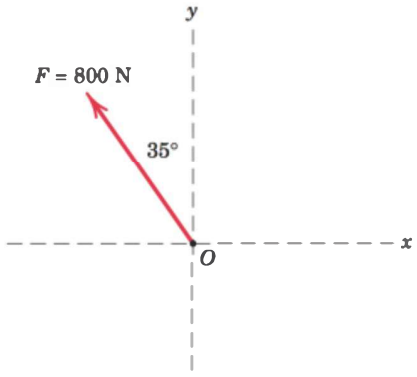
PROBLEMS

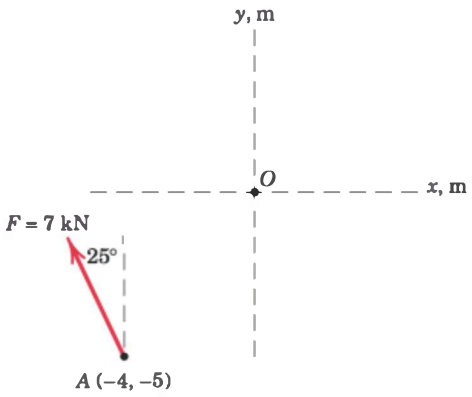
Introductory Problems

2/1 The force **F** has a magnitude of 800 N. Express **F** as a vector in terms of the unit vectors **i** and **j**. Identify the x and y scalar components of **F**.



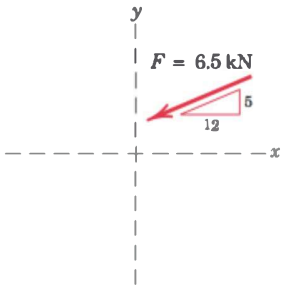
Problem 2/1

2/2 The force **F** has a magnitude of 7 kN and acts at the location indicated. Express **F** as a vector in terms of the unit vectors **i** and **j**. Next, determine the x and y scalar components of **F**.



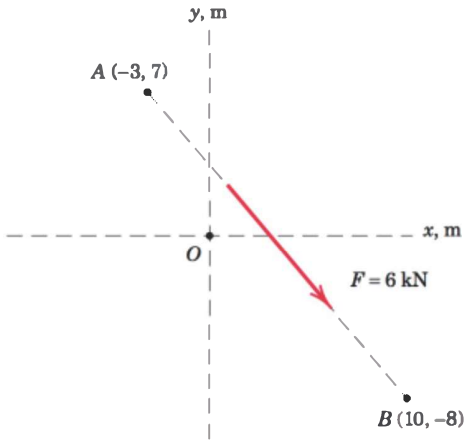
Problem 2/2

2/3 The slope of the 6.5-kN force **F** is specified as shown in the figure. Express **F** as a vector in terms of the unit vectors **i** and **j**.



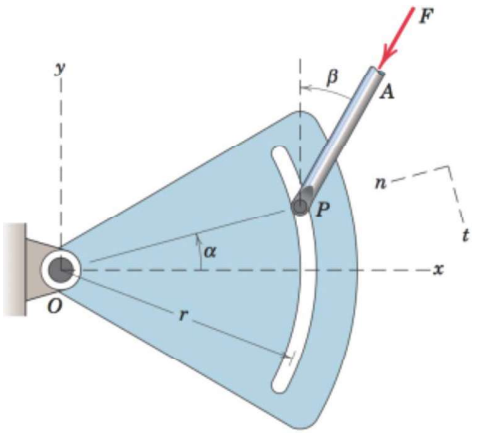
Problem 2/3

2/4 The force **F** has a magnitude of 6 kN and has the indicated line of action. Write the unit vector **n** associated with **F** and use **n** to determine the x and y scalar components of **F**.



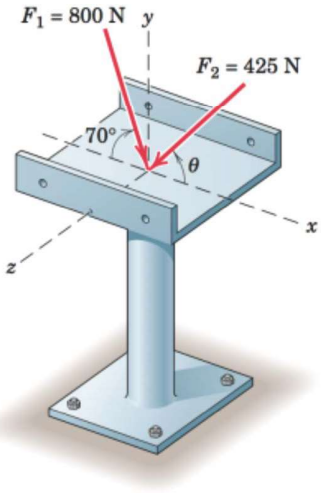
Problem 2/4

2/5 The control rod AP exerts a force **F** on the sector as shown. Determine both the x-y and the n-t components of the force.



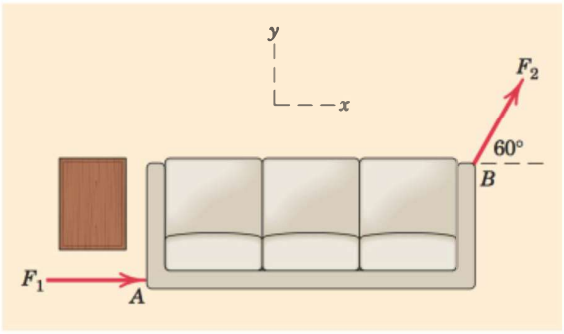
Problem 2/5

2/6 Two forces are applied to the construction bracket as shown. Determine the angle θ which makes the resultant of the two forces vertical. Determine the magnitude R of the resultant.



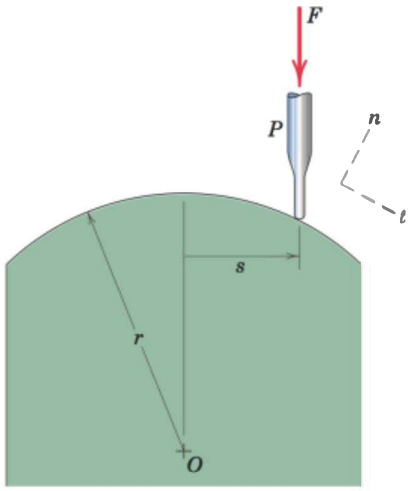
Problem 2/6

2/7 Two individuals are attempting to relocate a sofa by applying forces in the indicated directions. If $F_1 = 500$ N and $F_2 = 350$ N, determine the vector expression for the resultant **R** of the two forces. Then determine the magnitude of the resultant and the angle which it makes with the positive x-axis.



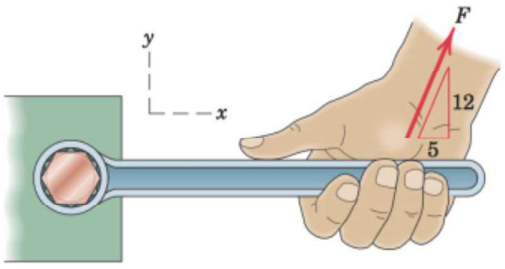
Problem 2/7

2/8 A small probe P is gently forced against the circular surface with a vertical force **F** as shown. Determine the n- and t-components of this force as functions of the horizontal position s.



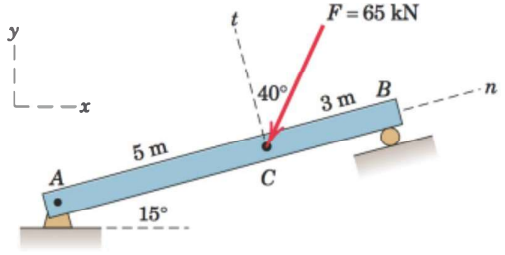
Problem 2/8

2/9 The y-component of the force **F** which a person exerts on the handle of the box wrench is known to be 320 N. Determine the x-component and the magnitude of **F**.



Problem 2/9

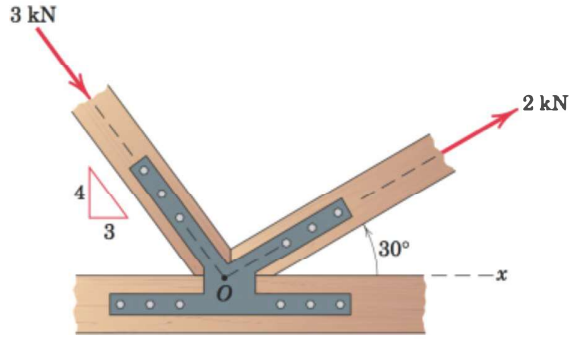
2/10 Determine the x-y and n-t components of the 65-kN force F acting on the simply-supported beam.



Problem 2/10

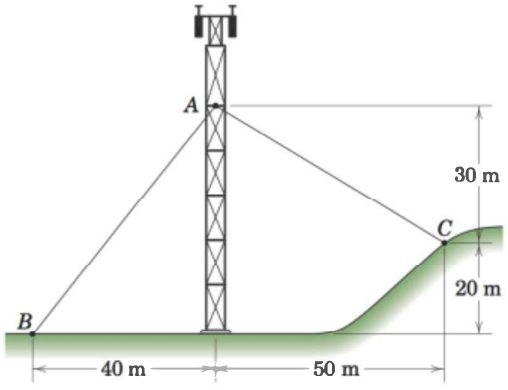
Representative Problems

2/11 The two structural members, one of which is in tension and the other in compression, exert the indicated forces on joint O. Determine the magnitude of the resultant $\mathbf{R}$ of the two forces and the angle θ which $\mathbf{R}$ makes with the positive x-axis.



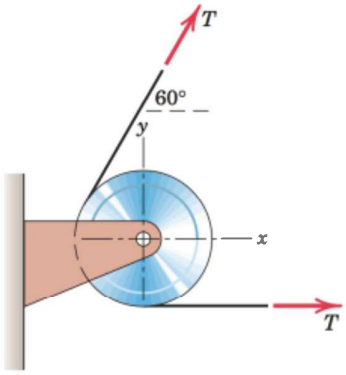
Problem 2/11

2/12 The guy cables AB and AC are attached to the top of the transmission tower. The tension in cable AB is 8 kN. Determine the required tension T in cable AC such that the net effect of the two cable tensions is a downward force at point A. Determine the magnitude R of this downward force.



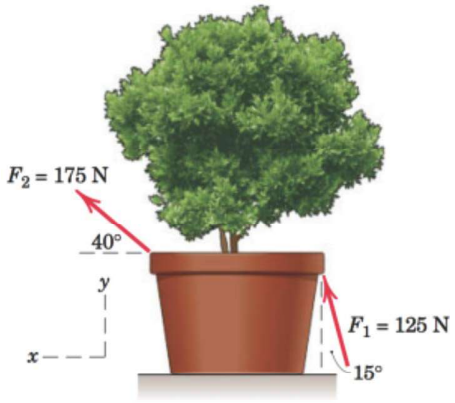
Problem 2/12

2/13 If the equal tensions T in the pulley cable are 400 N, express in vector notation the force $\mathbf{R}$ exerted on the pulley by the two tensions. Determine the magnitude of $\mathbf{R}$.



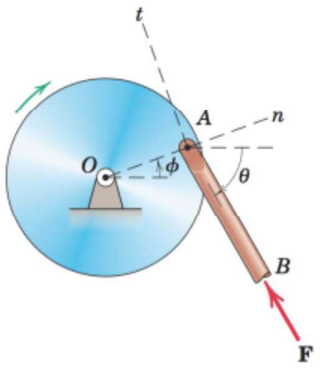
Problem 2/13

2/14 Two people exert the forces shown on the potted shrub. Determine the vector expression for the resultant $\mathbf{R}$ of the forces and determine the angle which the resultant makes with the positive y-axis.



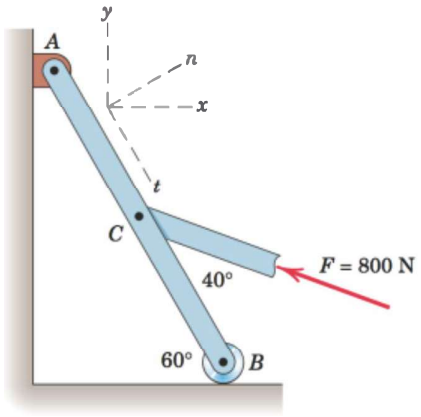
Problem 2/14

2/15 A compressive force $\mathbf{F}$ is transmitted via the coupler arm AB to disk OA. Develop the general expression for the n- and t-components of $\mathbf{F}$ as they act on the disk. Evaluate your expressions for (*a*) $F = 500$ N, $\theta = 60°$, $\phi = 20°$ and (*b*) $F = 800$ N, $\theta = 45°$, $\phi = 150°$.



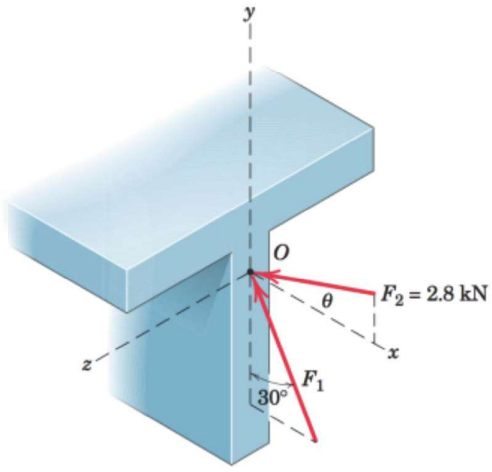
Problem 2/15

2/16 A force **F** of magnitude 800 N is applied to point C of the bar AB as shown. Determine both the x-y and the n-t components of **F**.



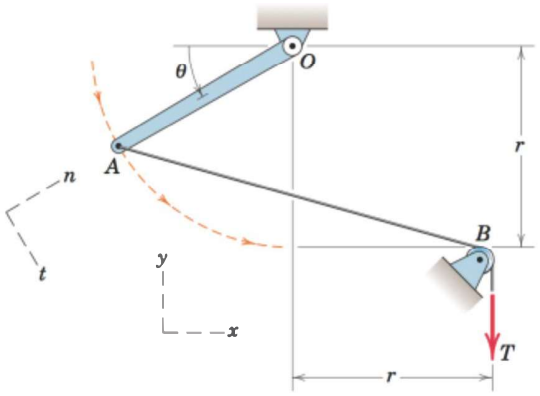
Problem 2/16

2/17 The two forces shown act in the x-y plane of the T-beam cross section. If it is known that the resultant **R** of the two forces has a magnitude of 3.5 kN and a line of action that lies 15° above the negative x-axis, determine the magnitude of $\mathbf{F}_1$ and the inclination θ of $\mathbf{F}_2$.



Problem 2/17

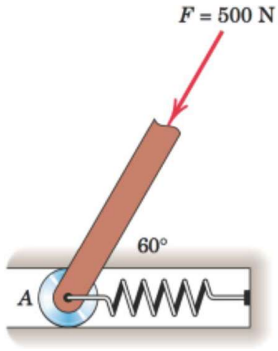
2/18 Determine the x- and y-components of the tension T which is applied to point A of the bar OA. Neglect the effects of the small pulley at B. Assume that r and θ are known.



Problem 2/18

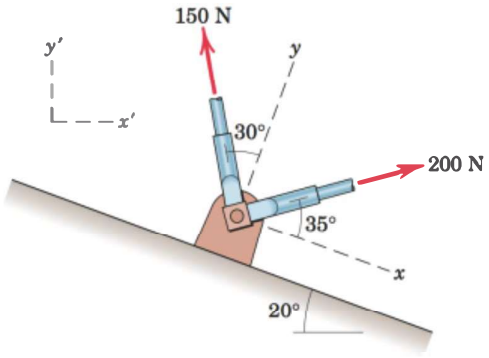
2/19 Refer to the mechanism of the previous problem. Develop general expressions for the n- and t-components of the tension T applied to point A. Then evaluate your expressions for $T = 100$ N and $\theta = 35°$.

2/20 Determine the magnitude F_s of the tensile spring force in order that the resultant of $\mathbf{F}_s$ and $\mathbf{F}$ is a vertical force. Determine the magnitude R of this vertical resultant force.



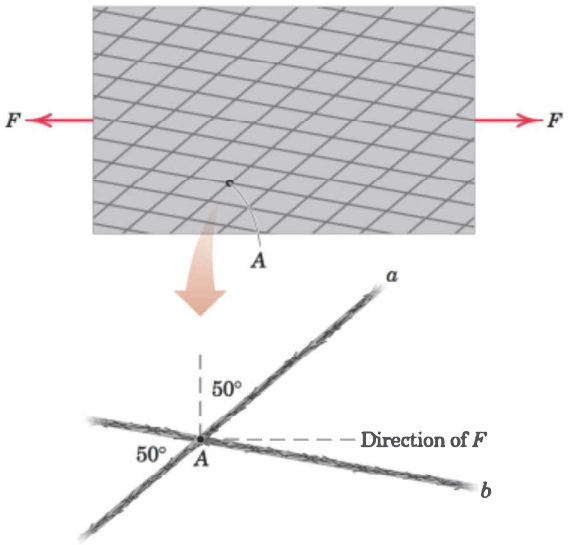
Problem 2/20

2/21 Determine the resultant $\mathbf{R}$ of the two forces applied to the bracket. Write $\mathbf{R}$ in terms of unit vectors along the x- and y-axes shown.



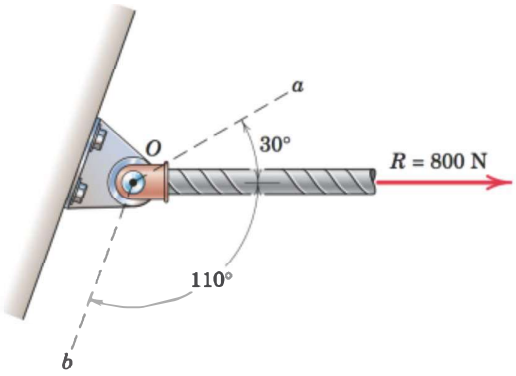
Problem 2/21

2/22 A sheet of an experimental composite is subjected to a simple tension test to determine its strength along a particular direction. The composite is reinforced by the Kevlar fibers shown, and a close-up showing the direction of the applied tension force $\mathbf{F}$ in relation to the fiber directions at point A is shown. If the magnitude of $\mathbf{F}$ is 2.5 kN, determine the components F_a and F_b of the force $\mathbf{F}$ along the oblique axes a and b. Also determine the projections P_a and P_b of $\mathbf{F}$ onto the a-b axes.



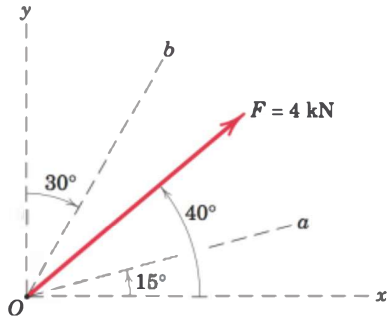
Problem 2/22

2/23 Determine the scalar components R_a and R_b of the force $\mathbf{R}$ along the nonrectangular axes a and b. Also determine the orthogonal projection P_a of $\mathbf{R}$ onto axis a.



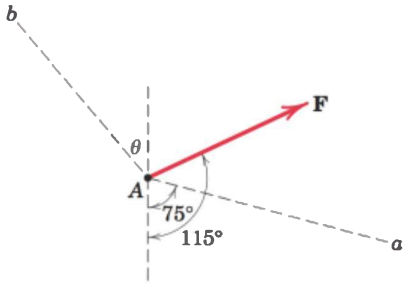
Problem 2/23

2/24 Determine the components F_a and F_b of the 4-kN force along the oblique axes a and b. Determine the projections P_a and P_b of $\mathbf{F}$ onto the a- and b-axes.



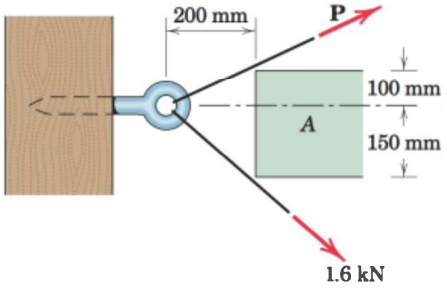
Problem 2/24

2/25 If the projection P_a and component F_b of the force **F** along oblique axes a and b are both 325 N, determine the magnitude F and the orientation θ of the b-axis.



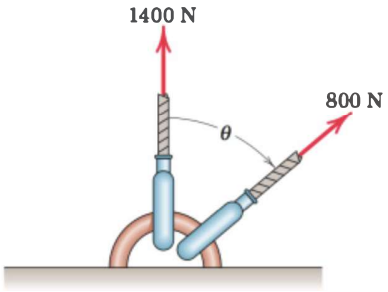
Problem 2/25

2/26 It is desired to remove the spike from the timber by applying force along its horizontal axis. An obstruction A prevents direct access, so that two forces, one 1.6 kN and the other **P**, are applied by cables as shown. Compute the magnitude of **P** necessary to ensure a resultant **T** directed along the spike. Also find T.



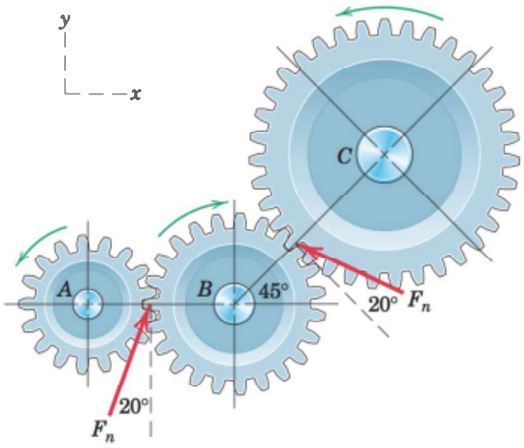
Problem 2/26

2/27 At what angle θ must the 800-N force be applied in order that the resultant **R** of the two forces have a magnitude of 2000 N? For this condition, determine the angle β between **R** and the vertical.



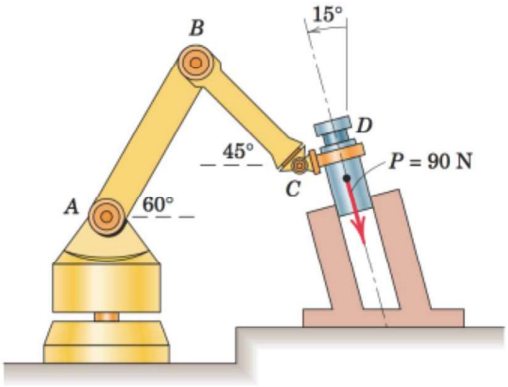
Problem 2/27

2/28 Power is to be transferred from the pinion A to the output gear C inside a mechanical drive. Because of output motion requirements and space limitations, an idler gear B is introduced as shown. A force analysis has determined that the total contact force between each pair of meshing teeth has a magnitude $F_n = 5500$ N, and these forces are shown acting on idler gear B. Determine the magnitude of the resultant **R** of the two contact forces acting on the idler gear. Complete both a graphical and a vector solution.



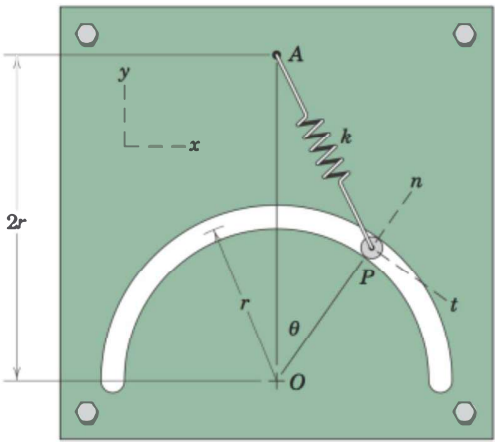
Problem 2/28

2/29 To insert the small cylindrical part into a close-fitting circular hole, the robot arm must exert a 90-N force P on the part parallel to the axis of the hole as shown. Determine the components of the force which the part exerts *on* the robot along axes (*a*) parallel and perpendicular to the arm AB, and (*b*) parallel and perpendicular to the arm BC.



Problem 2/29

▶2/30 The unstretched length of the spring is r. When pin P is in an arbitrary position θ, determine the x- and y-components of the force which the spring exerts on the pin. Evaluate your general expressions for $r = 400$ mm, $k = 1.4$ kN/m, and $\theta = 40°$. (*Note:* The force in a spring is given by $F = k\delta$, where δ is the extension from the unstretched length.)



Problem 2/30