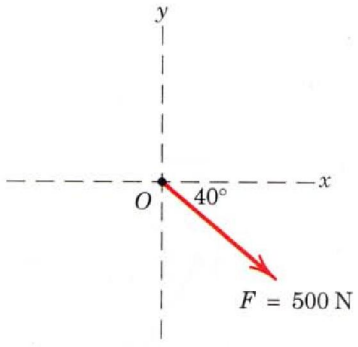
PROBLEMS

Introductory Problems

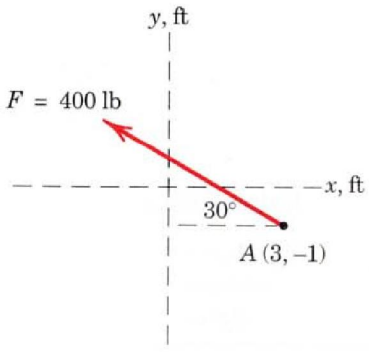
2/1 The force **F** has a magnitude of 500 N. Express **F** as a vector in terms of the unit vectors **i** and **j**. Identify the x and y scalar components of **F**.

Ans. $\mathbf{F} = 383\mathbf{i} - 321\mathbf{j}$ N, $F_x = 383$ N, $F_y = -321$ N



Problem 2/1

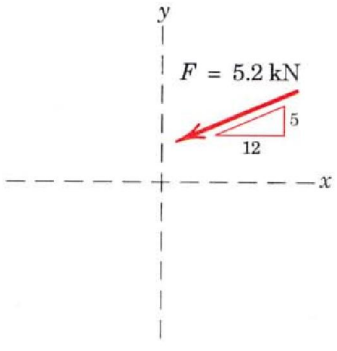
2/2 The magnitude of the force **F** is 400 lb. Express **F** as a vector in terms of the unit vectors **i** and **j**. Identify both the scalar and vector components of **F**.



Problem 2/2

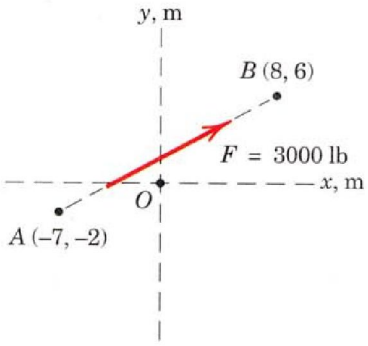
2/3 The slope of the 5.2-kN force **F** is specified as shown in the figure. Express **F** as a vector in terms of the unit vectors **i** and **j**.

Ans. $\mathbf{F} = -4.8\mathbf{i} - 2\mathbf{j}$ kN



Problem 2/3

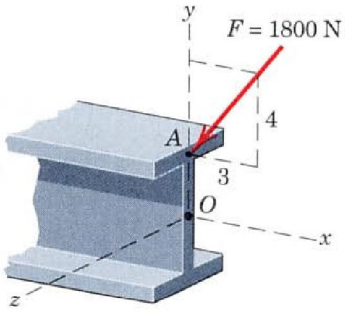
2/4 The line of action of the 3000-lb force runs through the points A and B as shown in the figure. Determine the x and y scalar components of **F**.



Problem 2/4

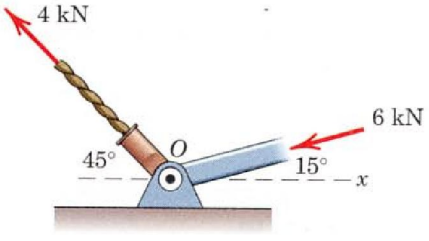
2/5 The 1800-N force **F** is applied to the end of the I-beam. Express **F** as a vector using the unit vectors **i** and **j**.

Ans. $\mathbf{F} = -1080\mathbf{i} - 1440\mathbf{j}$ N



Problem 2/5

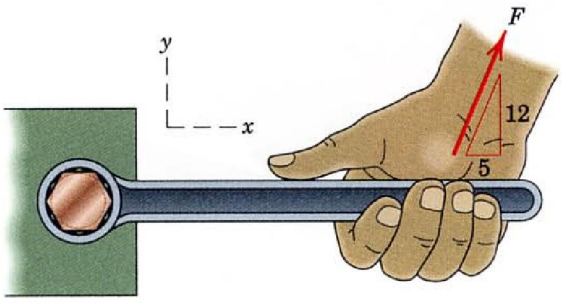
2/6 The two structural members, one of which is in tension and the other in compression, exert the indicated forces on joint O. Determine the magnitude of the resultant **R** of the two forces and the angle θ which **R** makes with the positive x-axis.



Problem 2/6

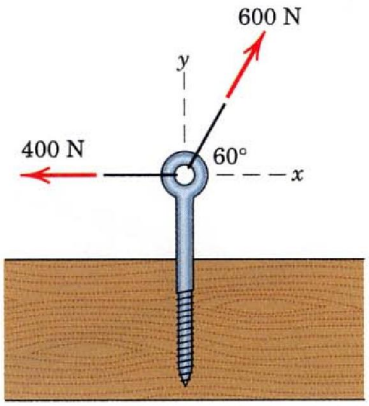
2/7 The y-component of the force $\mathbf{F}$ which a person exerts on the handle of the box wrench is known to be 70 lb. Determine the x-component and the magnitude of $\mathbf{F}$.

Ans. $F_x = 29.2$ lb, $F = 75.8$ lb



Problem 2/7

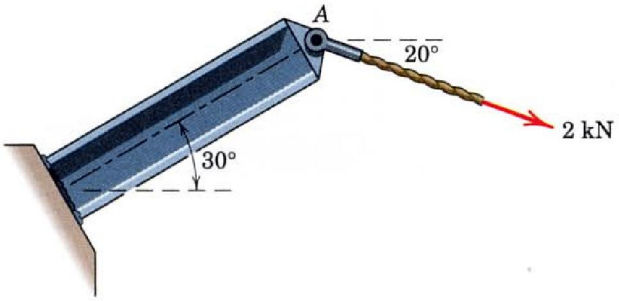
2/8 Determine the resultant $\mathbf{R}$ of the two forces shown by (*a*) applying the parallelogram rule for vector addition and (*b*) summing scalar components.



Problem 2/8

2/9 To satisfy design limitations it is necessary to determine the effect of the 2-kN tension in the cable on the shear, tension, and bending of the fixed I-beam. For this purpose replace this force by its equivalent of two forces at A, F_t parallel and F_n perpendicular to the beam. Determine F_t and F_n.

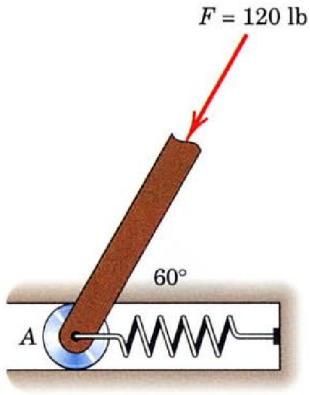
Ans. $F_t = 1.286$ kN, $F_n = 1.532$ kN



Problem 2/9

Representative Problems

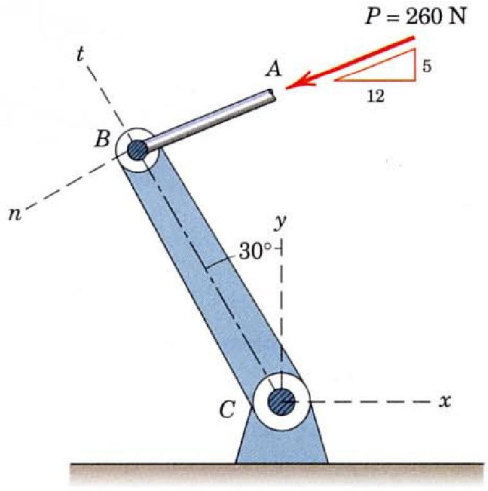
2/10 Determine the magnitude F_s of the tensile spring force in order that the resultant of $\mathbf{F}_s$ and $\mathbf{F}$ is a vertical force. Determine the magnitude R of this vertical resultant force.



Problem 2/10

2/11 In the design of a control mechanism, it is determined that rod AB transmits a 260-N force $\mathbf{P}$ to the crank BC. Determine the x and y scalar components of $\mathbf{P}$.

Ans. $P_x = -240$ N
$P_y = -100$ N

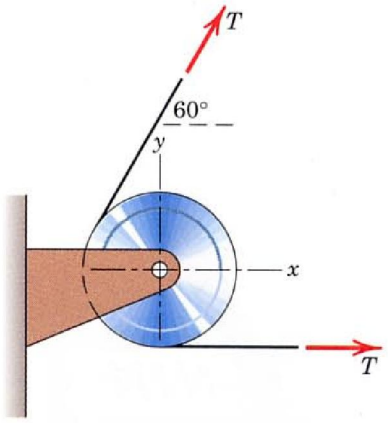


Problem 2/11

2/12 For the mechanism of Prob. 2/11, determine the scalar components P_t and P_n of $\mathbf{P}$ which are tangent and normal, respectively, to crank BC.

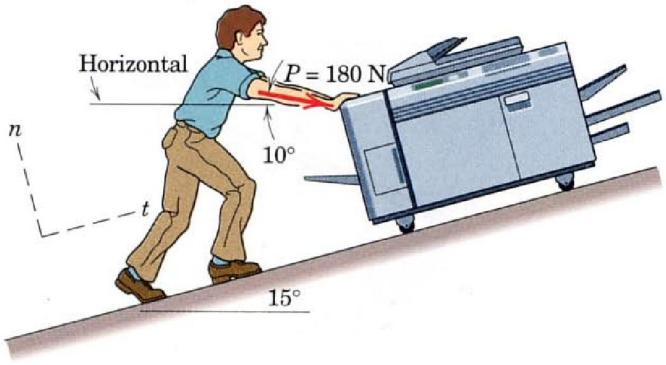
2/13 If the equal tensions T in the pulley cable are 400 N, express in vector notation the force $\mathbf{R}$ exerted on the pulley by the two tensions. Determine the magnitude of $\mathbf{R}$.

Ans. $\mathbf{R} = 600\mathbf{i} + 346\mathbf{j}$ N, $R = 693$ N



Problem 2/13

2/14 While steadily pushing the machine up an incline, a person exerts a 180-N force $\mathbf{P}$ as shown. Determine the components of $\mathbf{P}$ which are parallel and perpendicular to the incline.

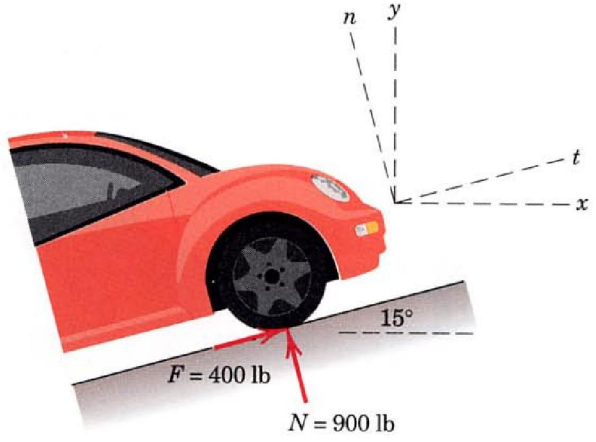


Problem 2/14

2/15 The normal reaction force N and the tangential friction force F act on the tire of a front-wheel-drive car as shown. Express the resultant $\mathbf{R}$ of these two forces in terms of the unit vectors (*a*) $\mathbf{i}$ and $\mathbf{j}$ along the x-y axes and (*b*) $\mathbf{e}_t$ and $\mathbf{e}_n$ along the n-t axes shown.

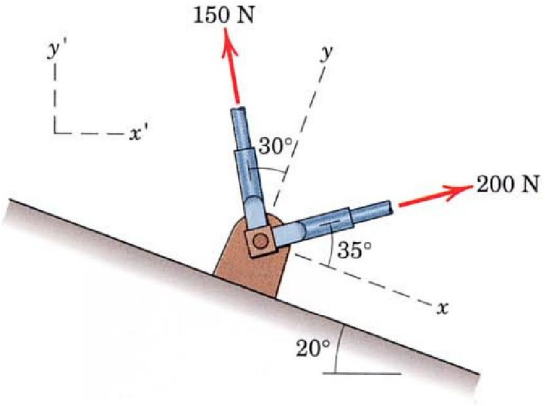
Ans. (*a*) $\mathbf{R} = 153.4\mathbf{i} + 973\mathbf{j}$ lb

(*b*) $\mathbf{R} = 400\mathbf{e}_t + 900\mathbf{e}_n$ lb



Problem 2/15

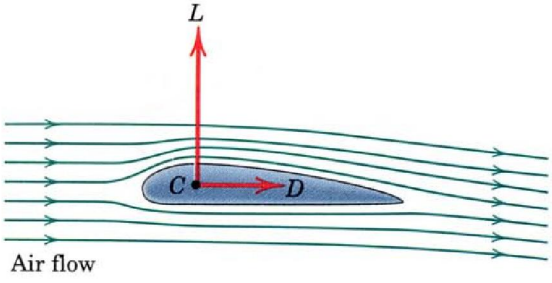
2/16 Determine the resultant $\mathbf{R}$ of the two forces applied to the bracket. Write $\mathbf{R}$ in terms of unit vectors along the x- and y-axes shown.



Problem 2/16

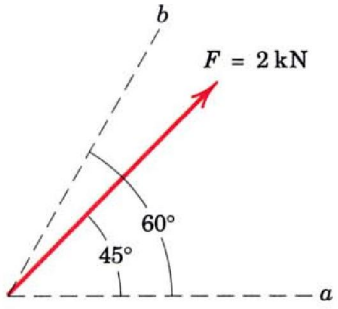
2/17 The ratio of the lift force L to the drag force D for the simple airfoil is $L/D = 10$. If the lift force on a short section of the airfoil is 50 lb, compute the magnitude of the resultant force $\mathbf{R}$ and the angle θ which it makes with the horizontal.

Ans. $R = 50.2$ lb, $\theta = 84.3°$



Problem 2/17

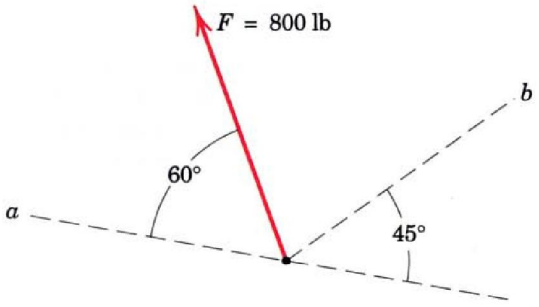
2/18 Determine the components of the 2-kN force along the oblique axes a and b. Determine the projections of **F** onto the a- and b-axes.



Problem 2/18

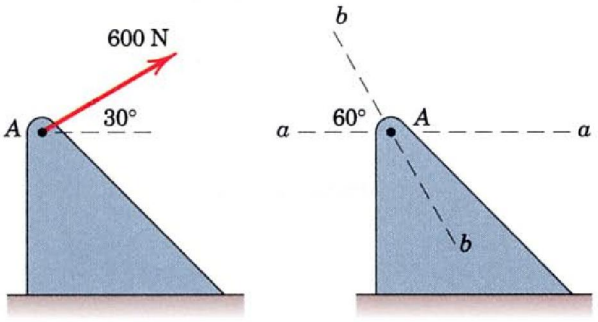
2/19 Determine the components of the 800-lb force **F** along the oblique axes a and b. Also, determine the projections of **F** onto the a- and b-axes.

Ans. Components: $F_a = 1093$ lb, $F_b = 980$ lb
Projections: $F_a = 400$ lb, $F_b = 207$ lb



Problem 2/19

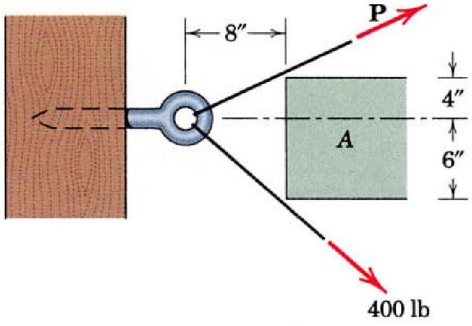
2/20 The 600-N force applied to the bracket at A is to be replaced by two forces, F_a in the a-a direction and F_b in the b-b direction, which together produce the same effect on the bracket as that of the 600-N force. Determine F_a and F_b.



Problem 2/20

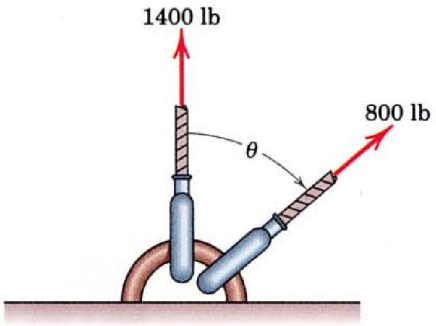
2/21 It is desired to remove the spike from the timber by applying force along its horizontal axis. An obstruction A prevents direct access, so that two forces, one 400 lb and the other **P**, are applied by cables as shown. Compute the magnitude of **P** necessary to ensure a resultant **T** directed along the spike. Also find T.

Ans. $P = 537$ lb
$T = 800$ lb



Problem 2/21

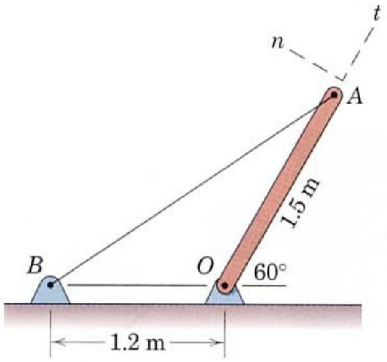
2/22 At what angle θ must the 800-lb force be applied in order that the resultant **R** of the two forces has a magnitude of 2000 lb? For this condition, determine the angle β between **R** and the vertical.



Problem 2/22

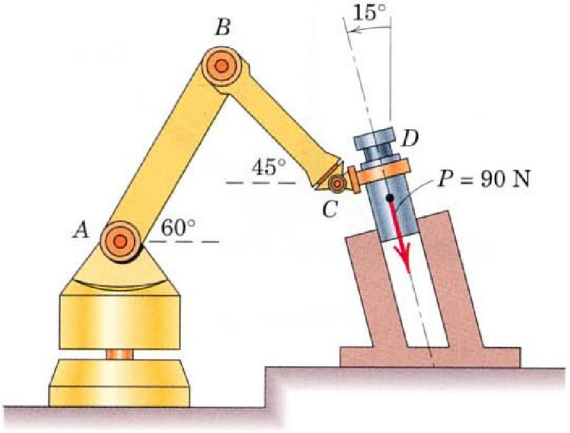
2/23 The cable AB prevents bar OA from rotating clockwise about the pivot O. If the cable tension is 750 N, determine the n- and t-components of this force acting on point A of the bar.

Ans. $T_n = 333$ N, $T_t = -672$ N



Problem 2/23

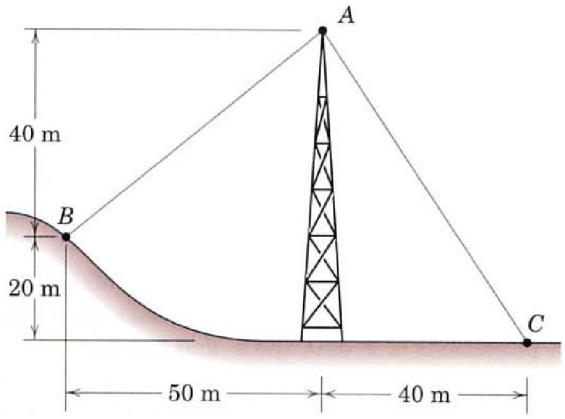
2/24 In the design of the robot to insert the small cylindrical part into a close-fitting circular hole, the robot arm must exert a 90-N force P on the part parallel to the axis of the hole as shown. Determine the components of the force which the part exerts *on* the robot along axes (*a*) parallel and perpendicular to the arm AB, and (*b*) parallel and perpendicular to the arm BC.



Problem 2/24

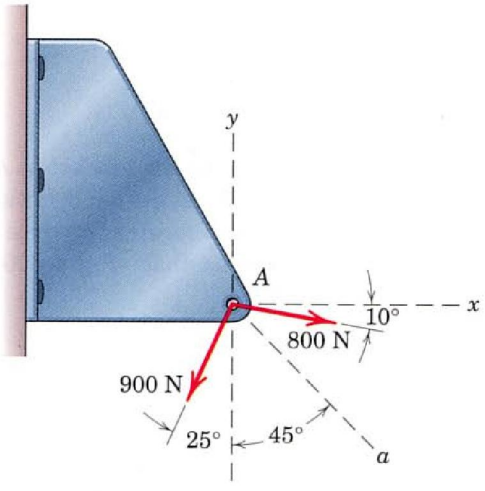
2/25 The guy cables AB and AC are attached to the top of the transmission tower. The tension in cable AC is 8 kN. Determine the required tension T in cable AB such that the net effect of the two cable tensions is a downward force at point A. Determine the magnitude R of this downward force.

Ans. $T = 5.68$ kN, $R = 10.21$ kN



Problem 2/25

2/26 The gusset plate is subjected to the two forces shown. Replace them by two equivalent forces, F_x in the x-direction and F_a in the a-direction. Determine the magnitudes of F_x and F_a. Solve geometrically or graphically.



Problem 2/26