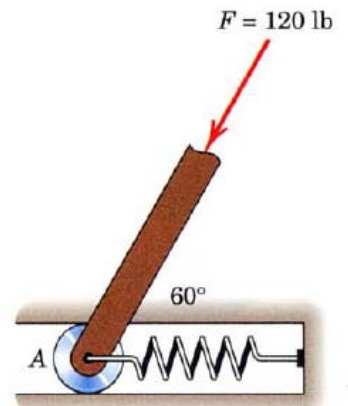Q/1

Determine the magnitude F_S of the tensile spring force in order that the resultant of F_S and F is a vertical force. Determine the magnitude R of this vertical resultant force.
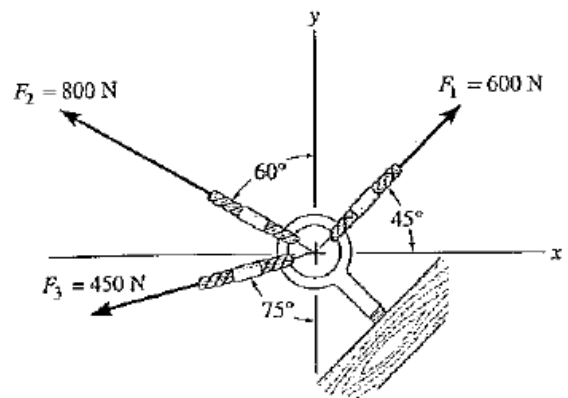
F = 120 lb

60°

A

Ams: $F_S = 60$ Ib

$R = 103.9$ Ib

Q/2

Determine the magnitude of the resultant force and its direction, measured counterclockwise from the positive x-axis.

$F_2 = 800$ N

$F_1 = 600$ N

60°

45°

$F_3 = 450$ N

75°

Ans: $R = 997.75$ N

$\theta = 134.8^{o}$

Q/3

Determine the angle θ for connecting member A to the plate so that the resultant force of F_A and F_B is directed horizontally to the right. Also, what is the magnitude of the resultant force?

$F_A = 8$ kN

θ

A

40°

B

$F_B = 6$ kN
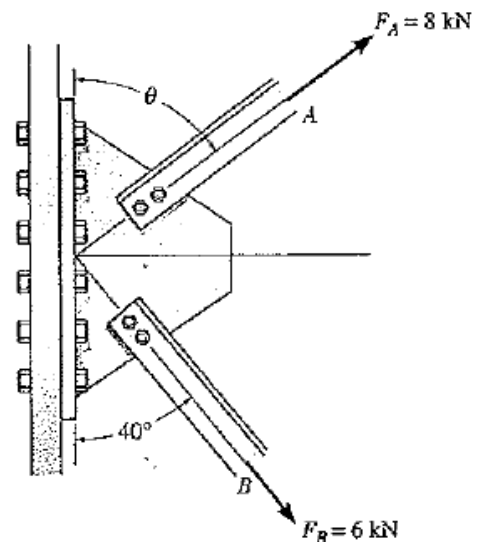
Ans: $\theta = 54.9^{o}$, $R = 10.4$ kN

Q/4

Four forces are exerted on the eyebolt as shown. If the net effect on the bolt is a direct pull of 600 Ib in the y-direction, determine the necessary values of T and θ.

240 lb

360 lb

T

400 lb

30°

30°

θ
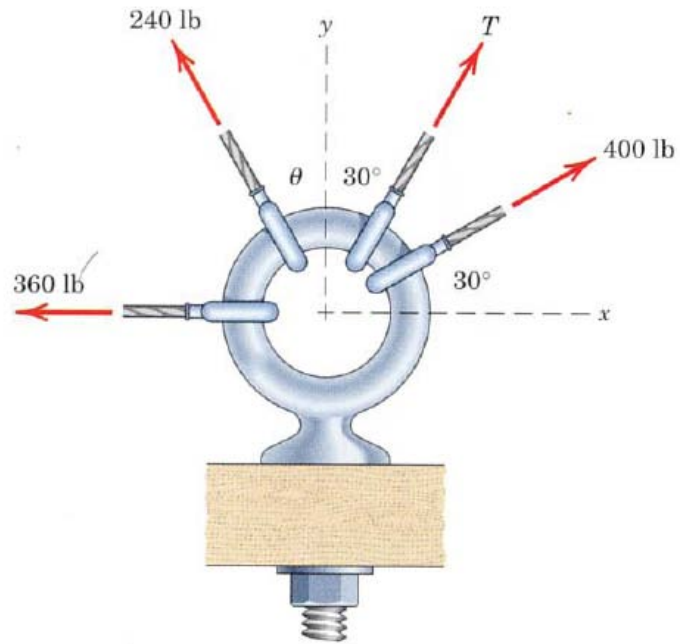
Ans: $T = 204$ Ib, $\theta = 21.7^{\circ}$

Q/5

The vertical force F acts downward at A o the two membered frame. Determine the magnitudes of the two components of F directed along the axes of AB and AC. Set F = 500 N.
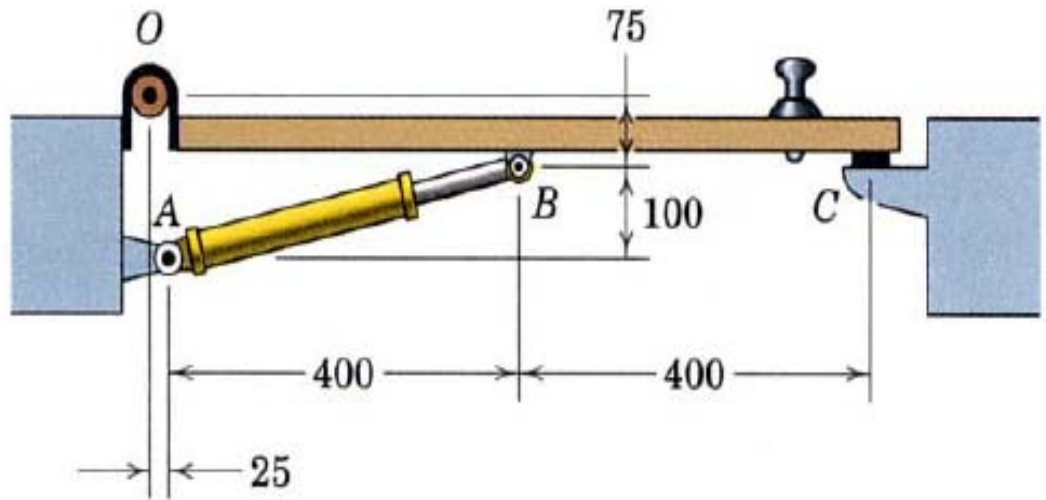

B

45°

A

F

30°

C
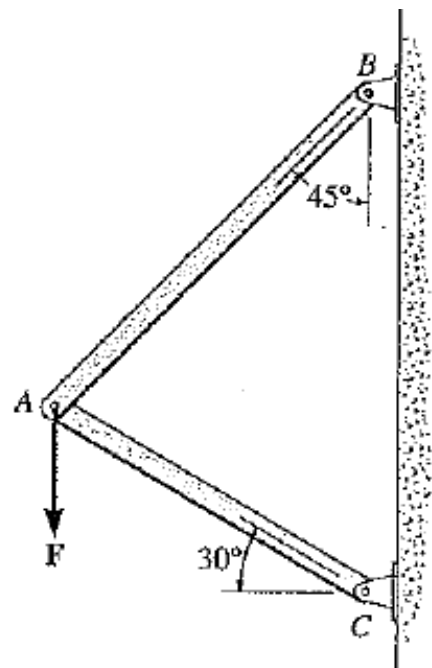
Ans: $F_{AB} = 448$ N

$F_{AC} = 366$ N

Q/6

The force exerted by the plunger of cylinder AB on the boor is 40 N directed along the line AB, and this force tends to keep the door closed. Compute the moment of this force about the hinge O. what force F_C normal to the plane of the door must the door stop at c exert on the door so that the combined moment about O of the two forces is zero?
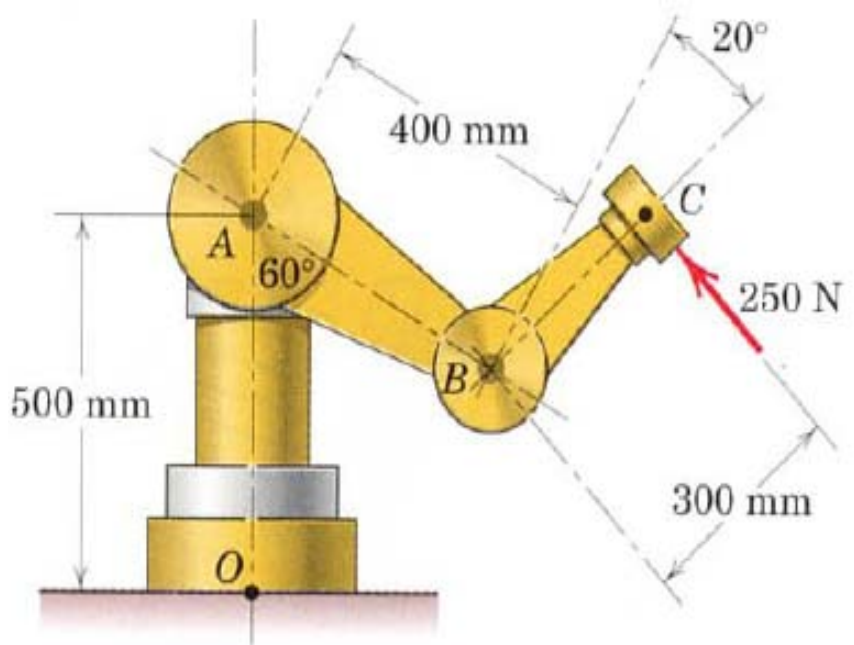
Ans:

$M_O = 7.03$ N.m

FC = 8.53 N

Q/7

Calculate the moment M_O of the 250 N force about the base point O of the robot.

Ans: $M_O = 189.6$ N.m CCW

Q/8

The piston, connecting rod, and crankshaft of a diesel engine are shown in the figure. The crank throw OA is half the stroke of 8 in., and the length AB of the rod is 14 in. for the position indicated, the rod is under a compression along AB of 3550 Ib. determine the moment M of this force about the crankshaft axis O.
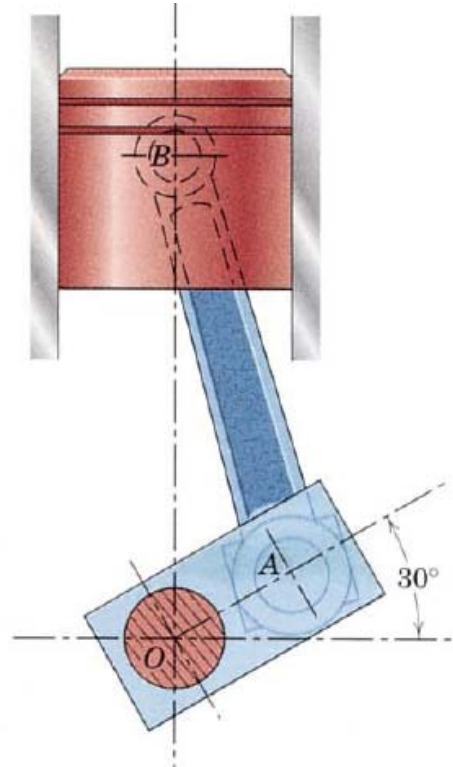
Ans. $M_O = 13670$ Ib.in

Q/9

Each propeller of the twin-screw ship develops a full-speed thrust of 300 kN. In maneuvering the ship, one propeller is turning full speed ahead and the other full speed in reverse. What thrust p must each tug exert on the ship to counteract the turning effect of the ship's propellers?
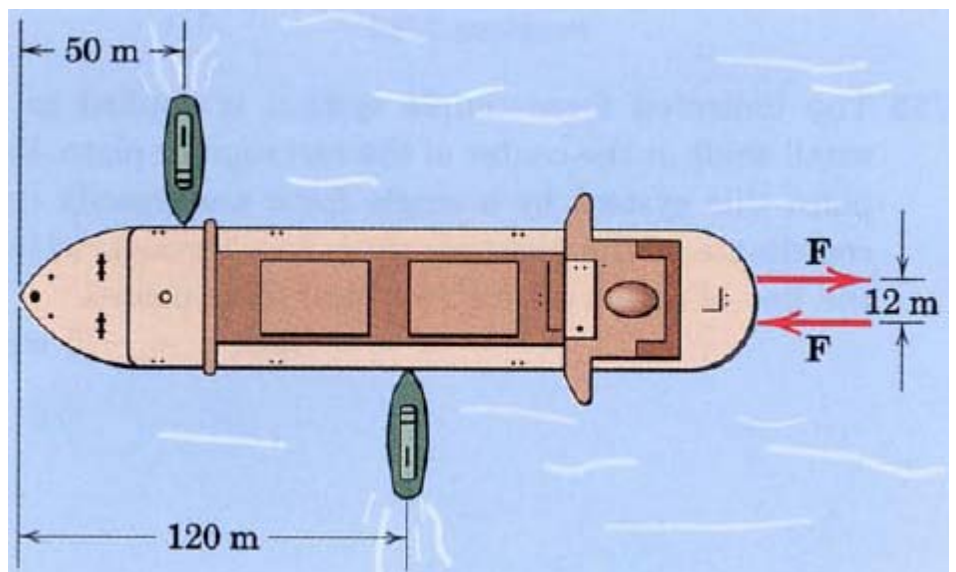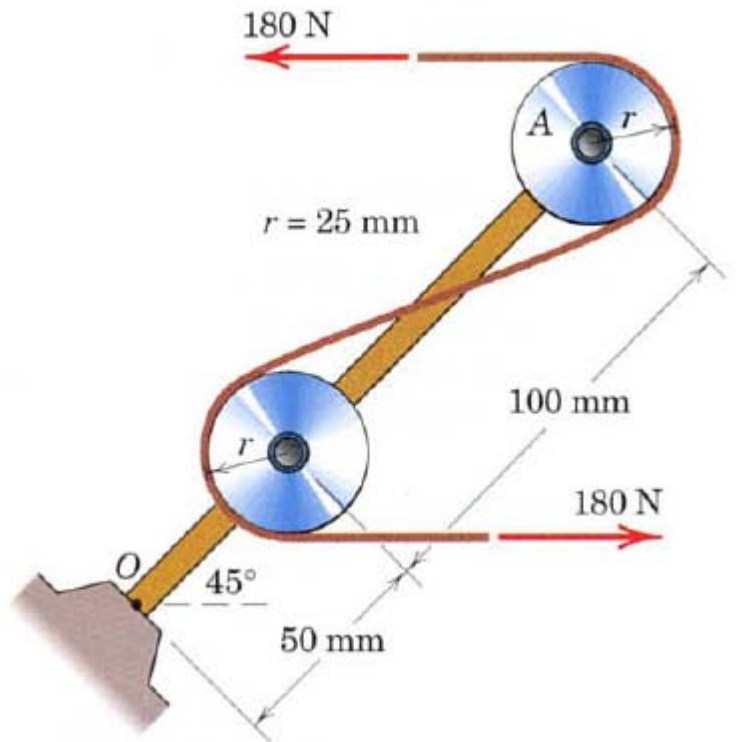
Ans.

P = 51.4 kN

Q/10

The system consisting of the bar OA, two identical pulleys, and a section of thin tape is subjected to the two 180 N tensile forces shown in the figure. Determine the equivalent force-couple system at point O.
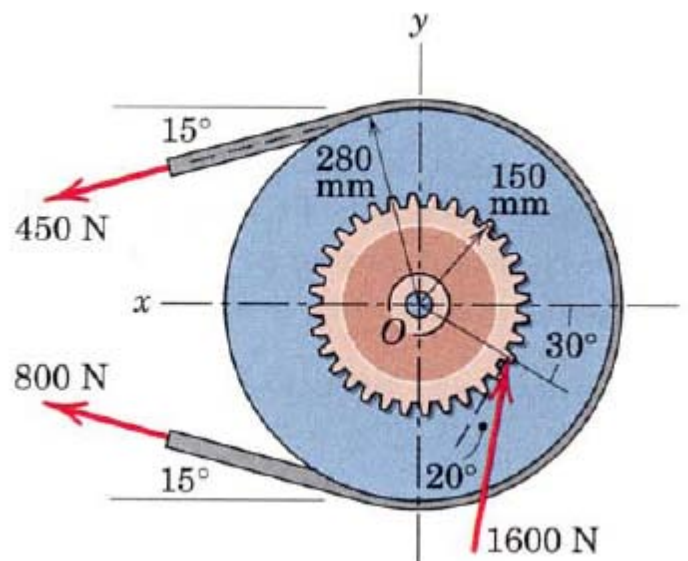
Ans.

$M_O = 21700$ N.mm

Q/11

The gear and attached V-belt pulley are turning counterclockwise and are subjected to the tooth load of 1600 N and the 800 N and 450 N tensions in the V-belt. Represent the action of these three forces by a resultant force R at O and a couple of magnitude M. is the unit slowing down or speeding up?
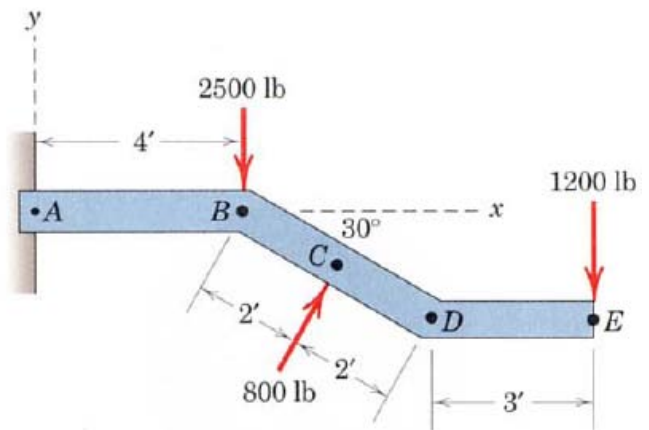
Ans.

R = 1908 N

$M_O = 127.5$ N.m CCW

Q/12

Replace the three forces which act on the bent bar by a force-couple system at the support point A.

Ans.

R = 3036 Ib
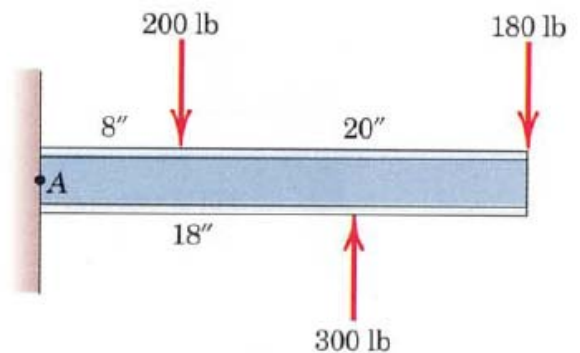
M_A = 18190 Ib-ft CW

Q/13

Reduce the given loading system to a force-couple system at point A. then determine the distance x to the right of point A at which the resultant of the three forces acts.


Ans.

R = 80 Ib down

M_A = 1240 Ib.in CW

x = 15.5 in.

Q/13

The elements of a heavy-duty fluid valve are shown in the figure. When the member OB rotates clockwise about the fixed pivot O under the action of the force P, the element S slides freely upward in its slot, releasing the flow. If an internal tensional spring exerts a moment M – 20 N.m as shown, determine the force p required to open the valve. Neglect all friction.
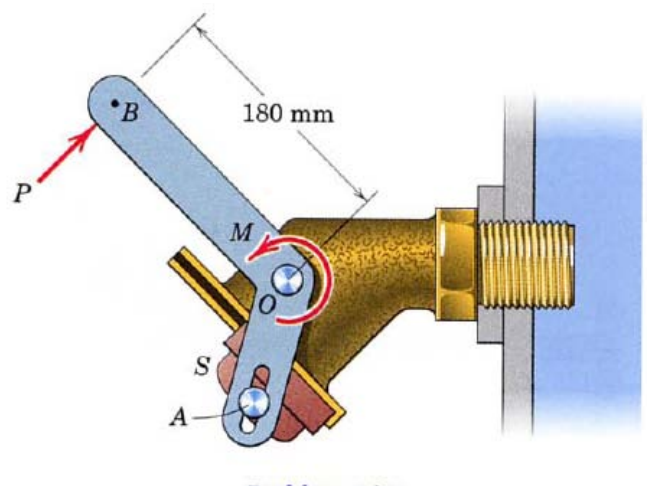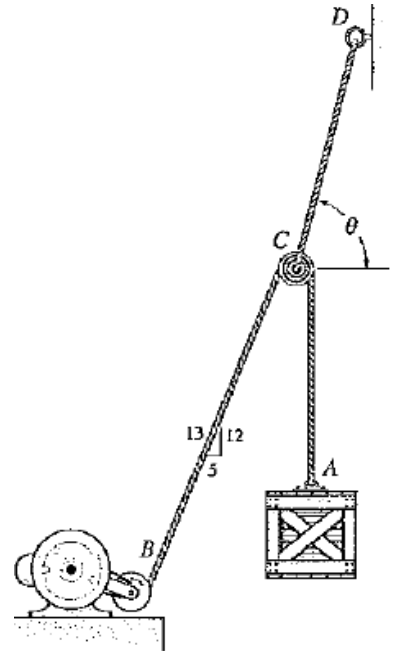

Ans.

P = 111.1 N

Q/14

The cords BCA and CD can each support a maximum load of 100 Ib. determine the maximum weight of the crate that can be hoisted at constant velocity, and the angle θ for equilibrium.
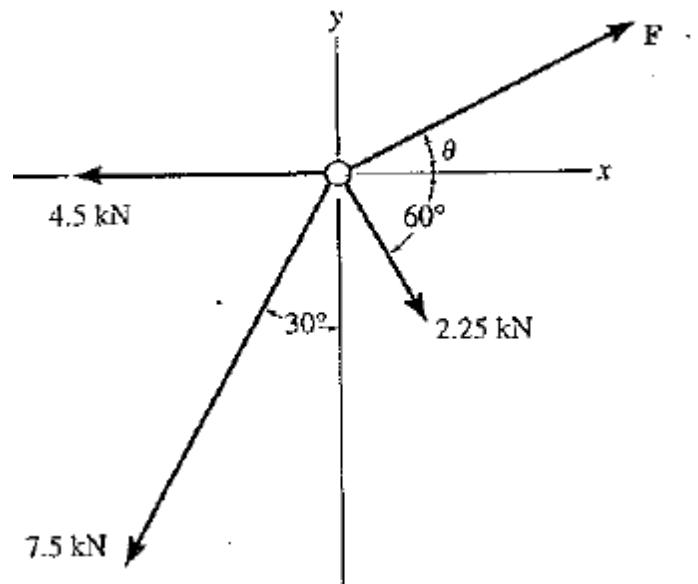
Ans.

$\theta = 78.7^{\circ}$

$W = 51$ Ib

Q/15

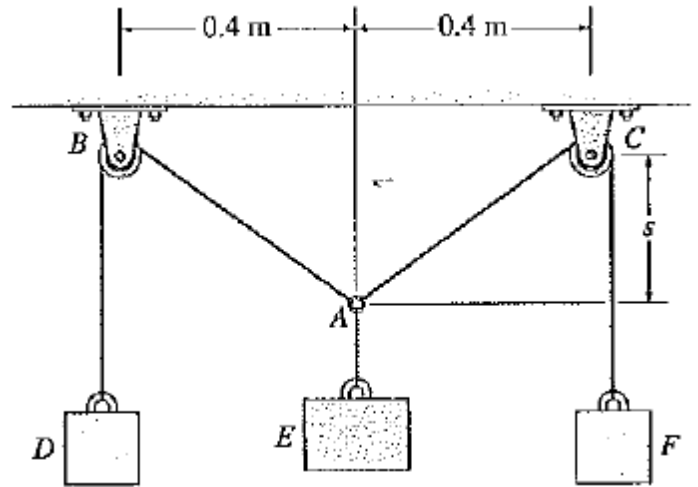Determine the magnitude and angle θ of F so that the particle is in equilibrium.

Ans.

$\theta = 49.8^{\circ}$

$F = 11$ kN

Q/16

If blocks D and F weight 5 N each, determine the weight of block E if the sag s = 0.3m. Neglect the size of the pulleys.
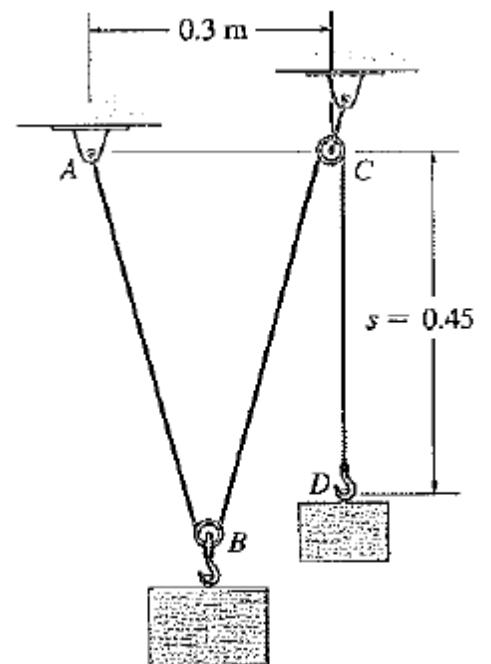
Ans.

W = 6 Ib

Q/17

A scale is constructed with a 1.2 m long cord and the 50 N block D. the cord is fixed to a pin at A and passes over two small pulleys. Determine the weight of the suspended block B if the system is in equilibrium when s = 1.45 m.
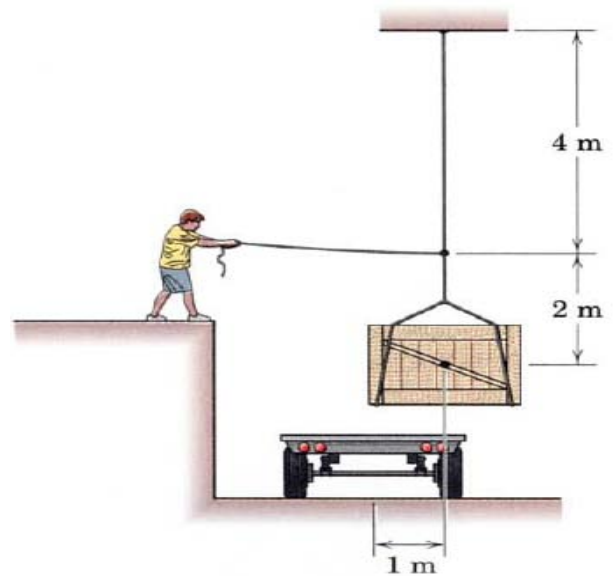
Ans.

W = 18.3 Ib

Q/18

What horizontal force p must a worker exert on the rope to position the 50 kg crate directly over the trailer?
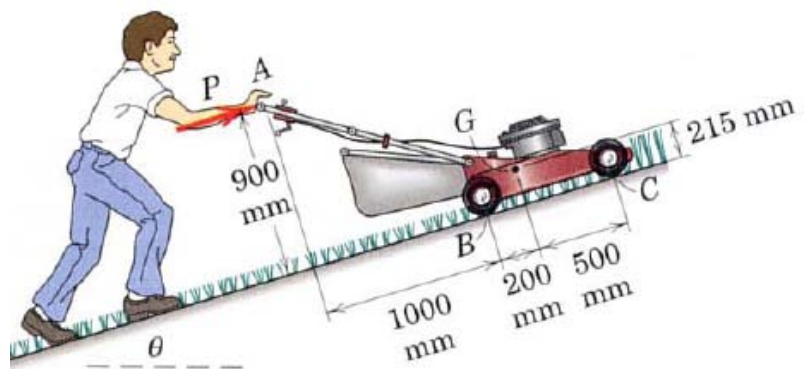

Ans.

P = 126.6 N

Q/19

The man pushes the lawn mower at a steady speed with a force P that is parallel to the incline. The mass of the mower with attached grass bag is 50 kg with mass center at G. if $\theta = 15^o$, determine the normal forces N_B and N_C under each pair of wheels B and C. neglect friction. Compare with the normal forces for the conditions of $\theta = 0$ and P = 0.

Ans.

$N_B = 214$ N, $N_C = 260$ N

With $\theta = P = 0$:

$N_B = 350$ N, $N_C = 140.1$ N

Q/20

Determine the force in each member of the loaded truss. Make use of the symmetry of the truss and of the loading.

Ans.

AB = DE = 96 kN C

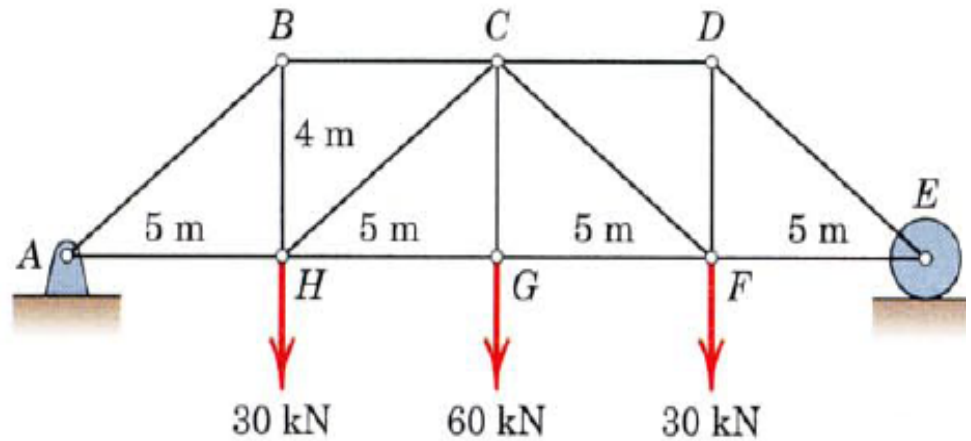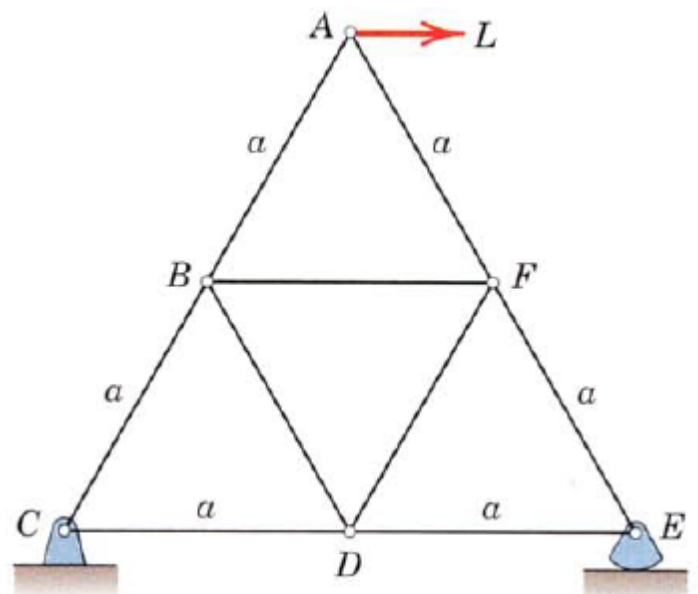AH = EG = 75 kN T

BC = CD = 75 kN C

BH = CG = DF 60 kN T

CH = CF = 49 kN C

GH = FG = 112.5 kN T

Q/21

The equiangular truss is loaded and supported as shown. Determine the forces in all members in terms of the horizontal load L.

Ans.

AB = BC = L T, AG = EF = L C

DE = CD = L/2 T, BF = DF = BD = 0

Q/22
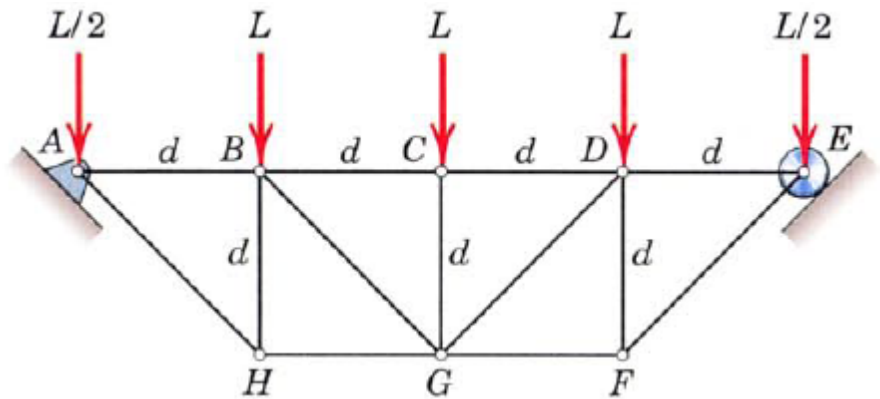
Determine the forces in members AB, CG, and DE of the loaded truss.

Ans.

AB = 7/2 L C
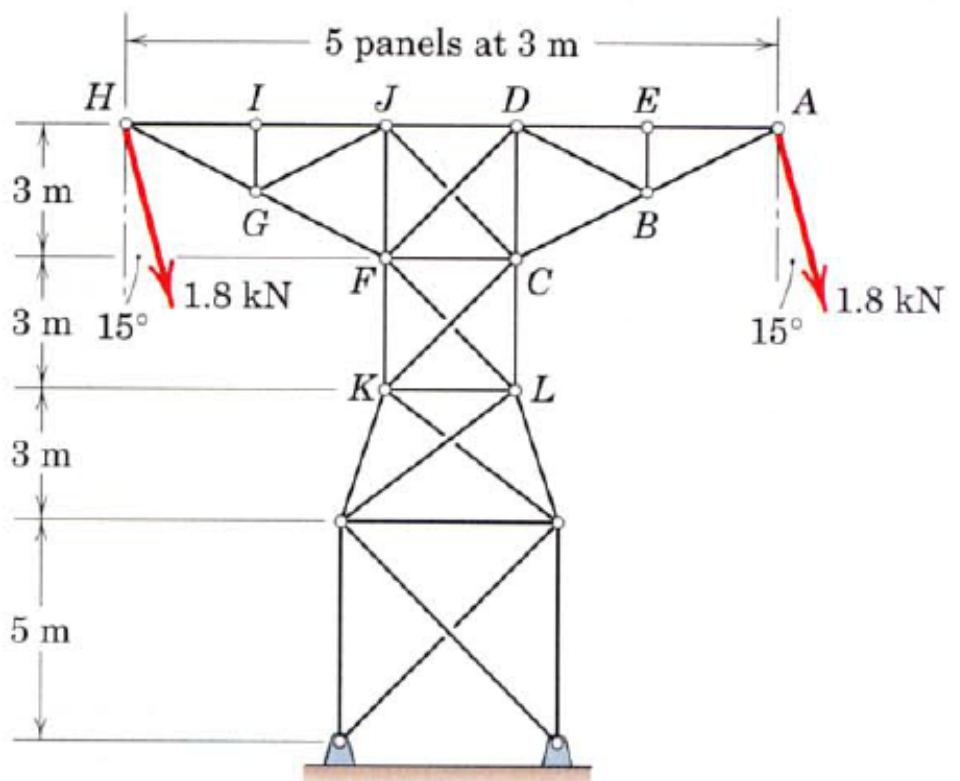
CG = L C

DE = 7/2 L C

Q/23

The tower for a transmission line is modeled by the truss shown. The crossed members in the center sections of the truss may be assumed to be capable of supporting tension only. For the loads of 1.8 kN applied in the vertical plane, compute the forces induced in members AB, DB, and CD.

Ans.

AB=3.89 kN C

DB = 0

CD = 0.932 kN C

Q/24

Determine the force in each member of the truss and state if the members are in tension or compression.

Ans.

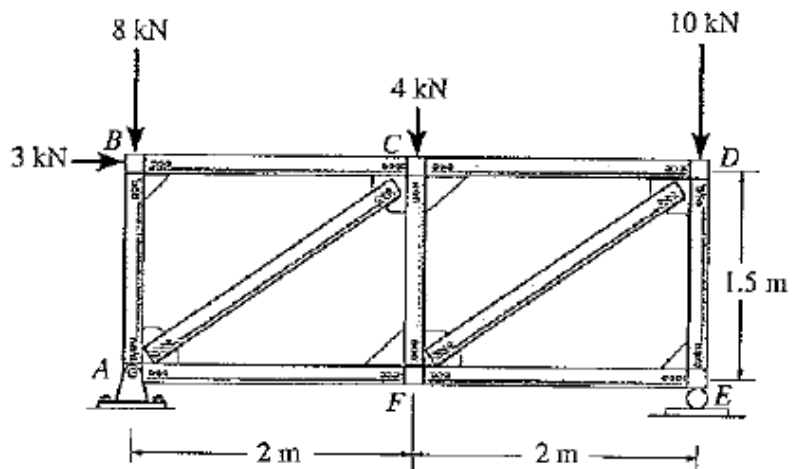BC = 3 kN C, BA = 8 kN C

AC = 1.46 kN C, AF = 4.17 kN T

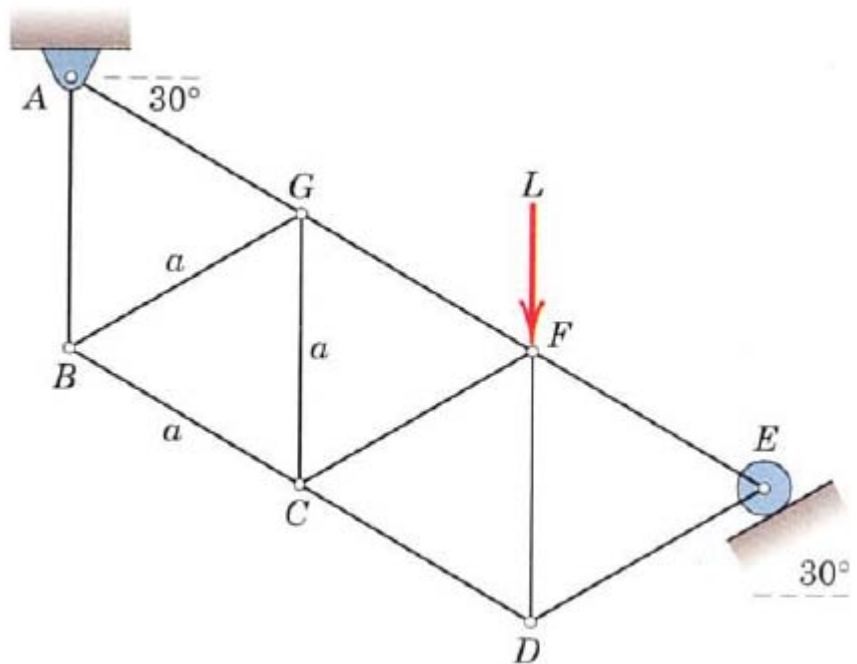CD = 4.17 kN C, CF = 3.12 kN C

ED = 13.1 kN C, DF 5.21 kN T

Q/25

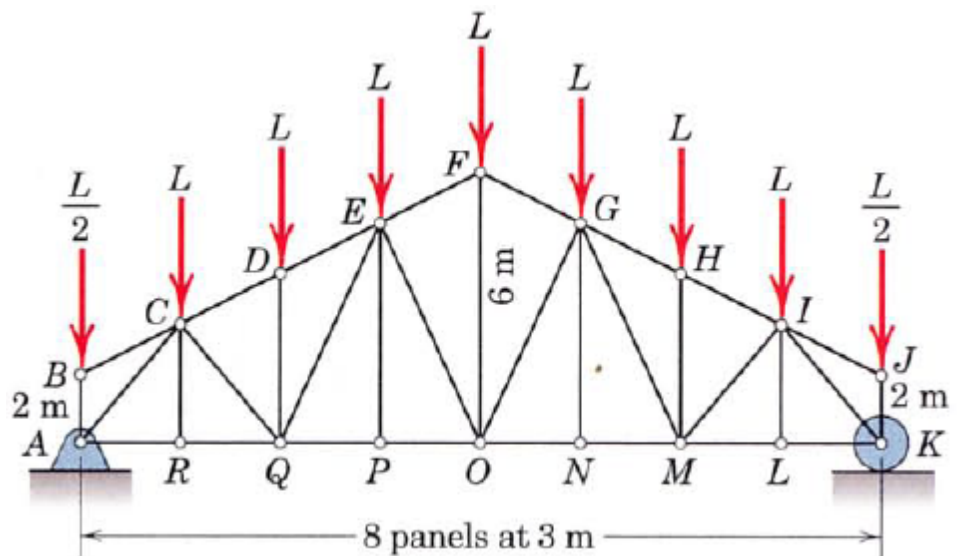Determine the force in member DG of the loaded truss.   Ans.   DG = L T
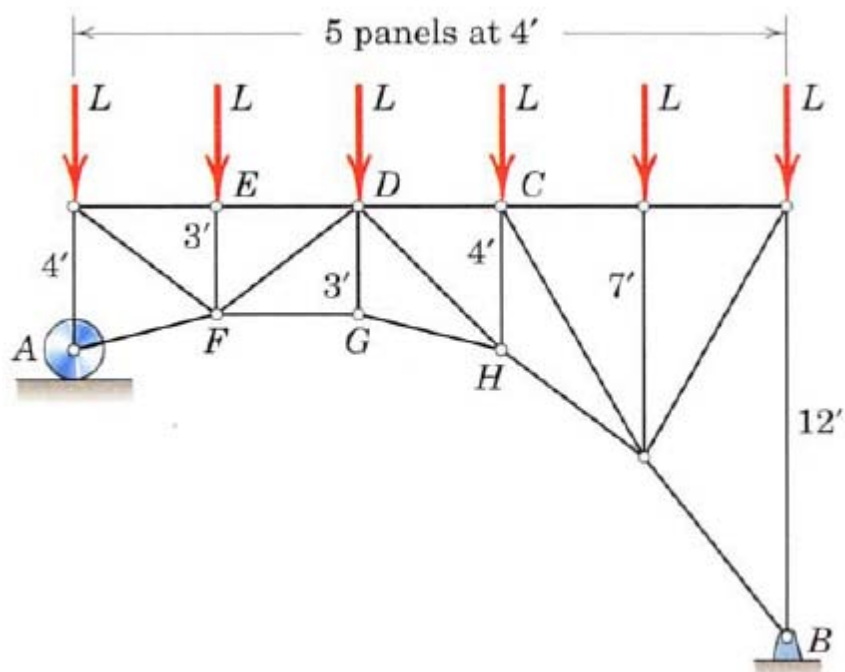
Q/26

The truss is composed of equilateral triangles of side a and is supported and loaded as shown. Determine the force in members DC and CG.   Ans. $BC = CG = L/3$ T
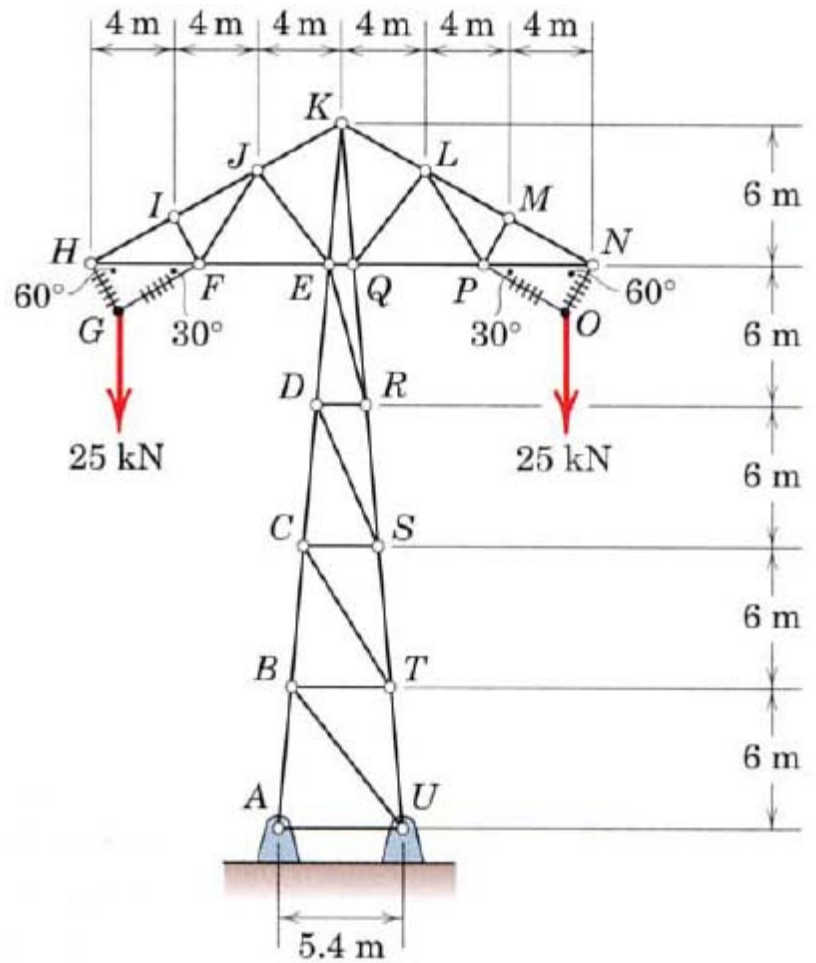

Q/27

Compute the force in member GM of the loaded truss.   Ans. $GM = 0$

A design model for a transmission-line tower is shown in the figure. Members GH, FFG, OP , and NO are insulate cables; all other members are steel bars. For the loading shown compute the forces in members FI, FJ, EJ, EK, and ER.
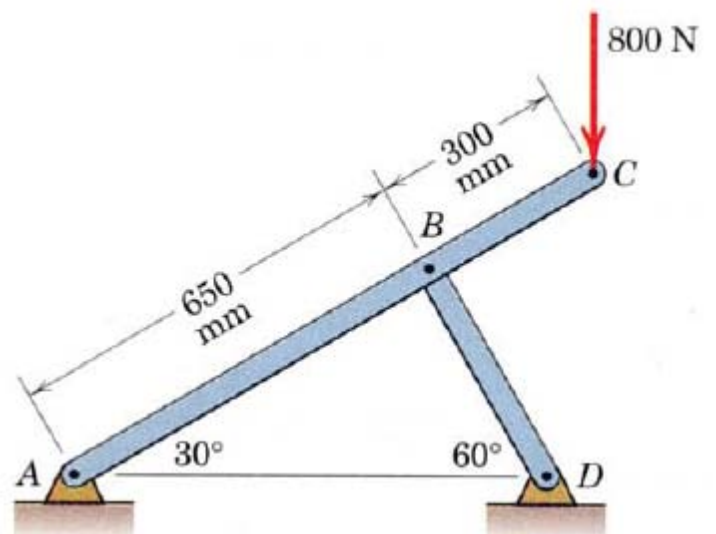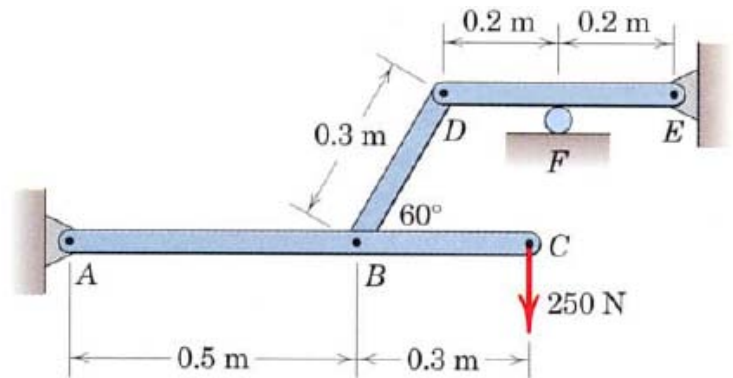

Ans.

FI = ER = 0, FJ = 7.81 kN T

EJ = 3.61 kN C, EK = 22.4 kN C

Q/29

Determine the magnitudes of all pin reactions for the frame loaded as shown.
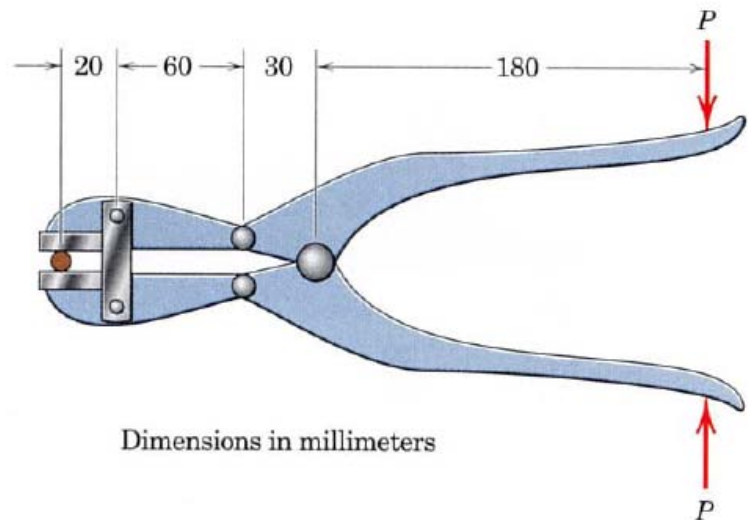

Ans. A = 512 N, B = D = 1013 N

Q/30

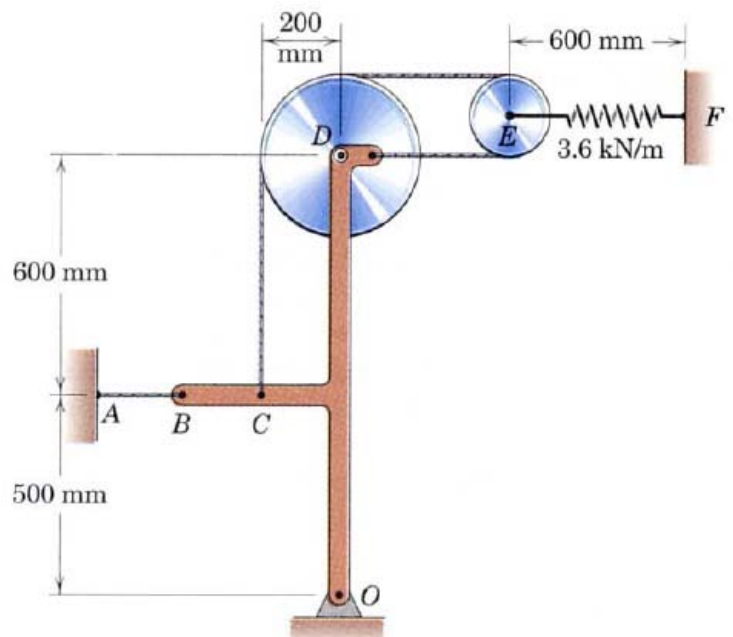Determine the reaction at the roller F for the frame loaded as shown.

Ans. F = 800 N

Q/31

A small bolt cutter operated by hand for cutting small bolts and rods is shown in the sketch. For a hand grip P = 150 N, determine the force Q developed by each jaw on the rod to be cut.

Ans. Q = 2.7 kN

Q/32

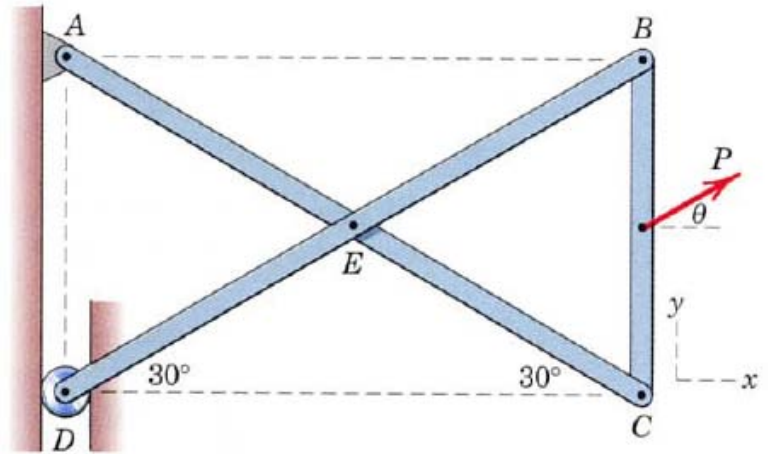The unstretched length of spring EF is 300 mm. determine the magnitude of the pin reaction at O.

Ans. O_X = 1512 N

O_Y = 0

Q/33

Determinne the x- and y- components of all forces acting on each member of the loaded frame for the conditions (a) $\theta = 0$ and (b) $\theta = 30^{\circ}$. Force P is applied to the midpoint of member BC.


Ans.

Q/34

The 85 Ib force P is applied to the 200 Ib crate, which is stationary before is applied. Determine the magnitude and direction of the friction force F exerted by the horizontal surface on the crate.
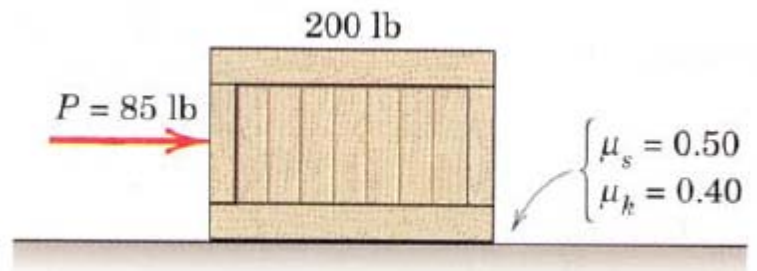
Ans. F = 85 Ib to the left

Q/35

The coefficients of static and kinetic friction between the 100 kg block and the inclined plane are 0.3 and 0.2, respectively. Determine (a) the frictio force F acting on the block when p is applied with a magnitude of 200 N to the block at rest, (b) the force P required to initiate motion up the incline from rest, and (c) the friction force F acting on the block if P = 600 N.
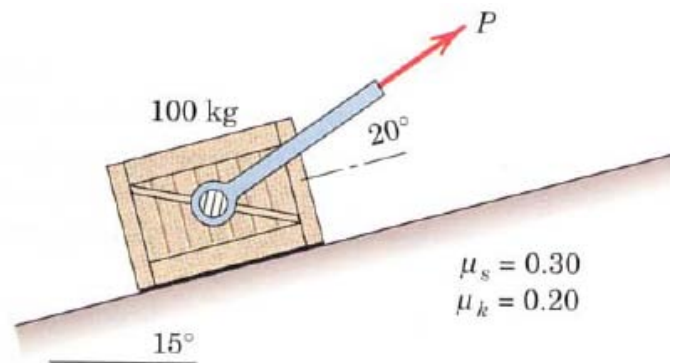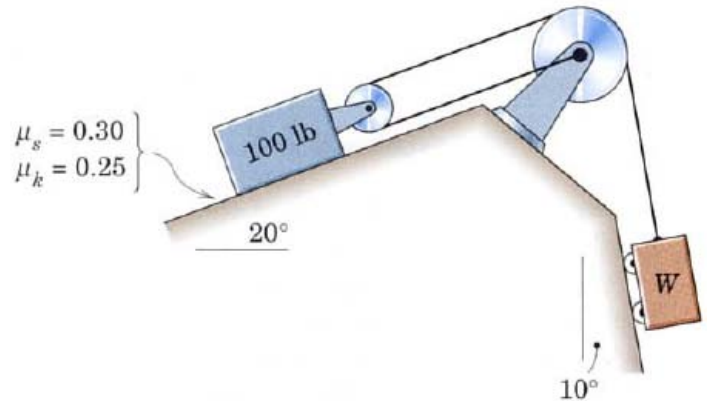

Ans.

    (a) F = 66 N up
    (b) P = 516 N
    (c) 148.5 N

Q/36

Determine the range of weights W for which the 100Ib block is in equilibrium. All wheels and pulleys have negligible friction.
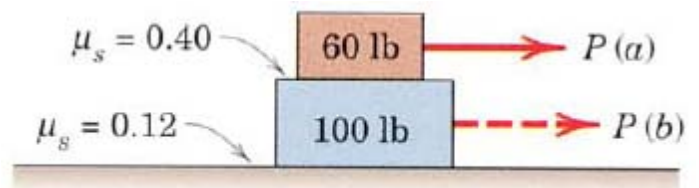

Ans.

$3.05 \text{ Ib} \le W \le 31.7 \text{ Ib}$

Q/37

The force P is applied to (a) the 60 Ib block and (b) the 100 Ib blick. For each case, determine the magnitude of p required to initiate motion.
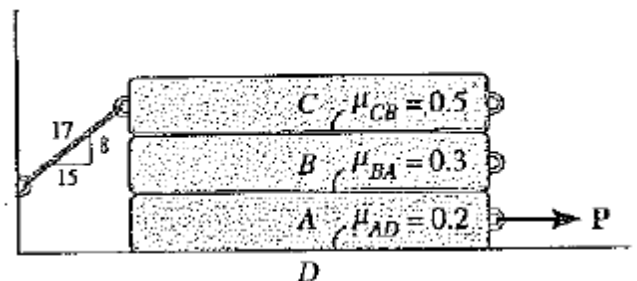

Ans.

$P(a) = P(b) = 19.2 \text{ Ib}$

Q/38

The three bars have a weight of $W_A = 20$ N, $W_B = 40$ N and $W_C = 60$ N, respectively. If the coefficients of static friction at the surfaces of contact are as shown, determine the smallest horizontal force P needed to move block A.

Ans.

$P = 63.5 \text{ Ib}$