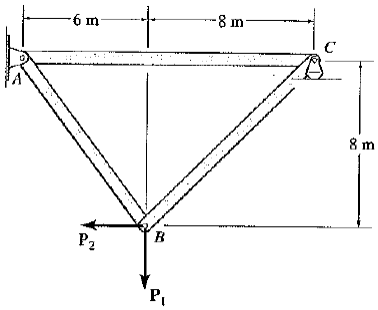
CE 221 ENGINEERING MECHANICS I (FALL 2014 – 2015)
Home Exercise IV –Equilibrium
(http://www2.ce.metu.edu.tr/~ce221)

Q1.

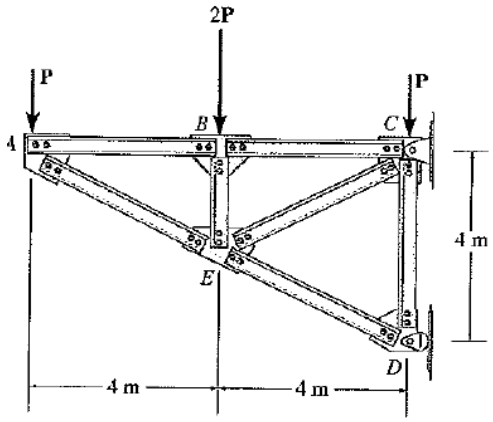
Determine the force in each member of the truss and state if the members are in tension or compression. Set $P_1 = 800$ kN and $P_2 = 400$ kN.



ANS: F_{BA}= 286 kN (T) F_{BC}= 808 kN (T) F_{CA}= 571 kN (C) C_y=571 kN

Q2.

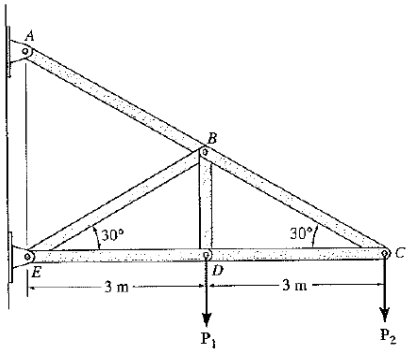
Assume that each member of the truss is made of steel having a mass per length of 4 kg/m. Set $P = 0$, determine the force in each member, and indicate if the members are in tension or compression. Neglect the weight of the gusset plates and assume each joint is a pin. Solve the problem by assuming the weight of each member can be represented as a vertical force, half of which is applied at the end of each member.



ANS: F_{AE}= 372 N (C), F_{AB}= 332 N (T), F_{BC}= 332 N (T), F_{BE}= 196 N (C), F_{EC}= 558 N (T), F_{ED}= 929 N (C), F_{DC}= 582 N (T)

Q3.

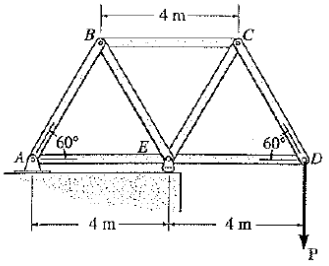
Determine the force in each member of the truss and state if the members are in tension or compression. Set $P_1 = 2$ kN and $P_2 = 1.5$ kN.



ANS: F_{CB}= 3kN (T), F_{CD}= 2.5 kN(C), F_{DE}=2.60 kN (C), 2.0 kN(T), F_{BE}=2.0 kN (C), F_{BA}= 5.0 kN (T)

Q4.

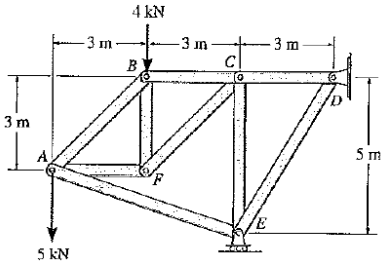
If the maximum force that any member can support is 8 kN in tension and 6 kN in compression, determine the maximum force P that can be supported at joint D.



ANS: P=5.2 kN

Q5.

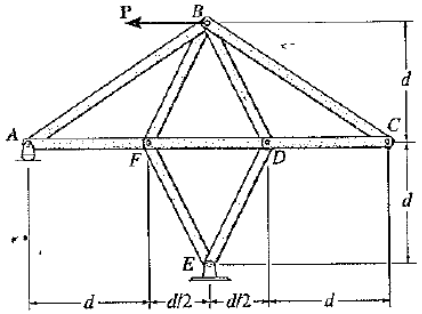
Determine the force in each member of the truss and state if the members are in tension or compression.



ANS: F_{DE}=16.3 kN (C), F_{DC}=8.4 kN (T), F_{EA}=8.85 kN (C), F_{EC}=6.2 kN(C), F_{CF}=8.77 kN (T), F_{CB}=2.2 kN (T), F_{BA}=3.11 kN (T), F_{BF}=6.2 kN (C), F_{FA}=6.2 kN (T)

Q6.

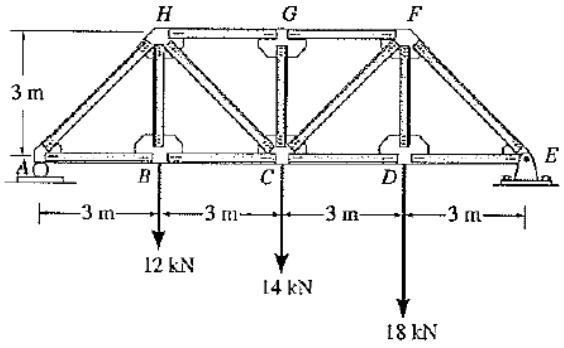
Determine the force in each member of the truss in terms of the load P, and indicate whether the members are in tension or compression.



ANS: F_{CB}=FCD=0, F_{AB}=2.40P (C), F_{AF}=2.0P (T) F_{BF}=1.86P (T), F_{BD}=0.373P(C)

Q7.

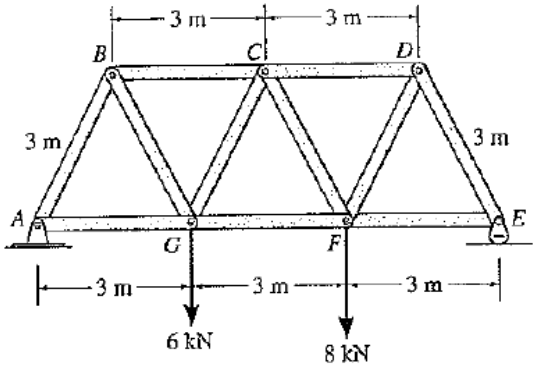
Determine the force in members GF, CF, and CD of the bridge truss, and indicate whether the members are in tension or compression



ANS: F_{GF}=29.0 kN (C), F_{CD}=23.5 kN (T), F_{CF}=7.78 kN(T)

Q8.

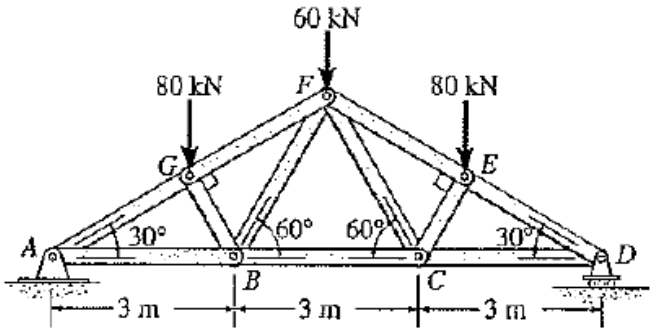
Determine the force in members *BC*, *CG*, and *GF* of the *Warren truss*. Indicate if the members are in tension or compression.



ANS: Ax=0, F_{GF}=8.08 kN (T), F_{BC}=7.7 kN (C), F_{CG}=0.77 kN (C)

Q9.

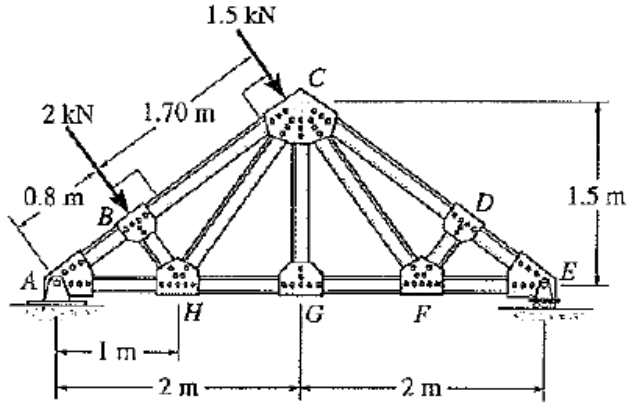
Determine the force in members *GF*, *FB*, and *BC* of the *Fink truss* and state if the members are in tension or compression.



ANS: Ax=0, FGF=Ay= 110 kN, F_{GF}= 180 (C), F_{FB}= 69.3 kN(T), F_{BC}= 52,83 kN (T)

Q10.

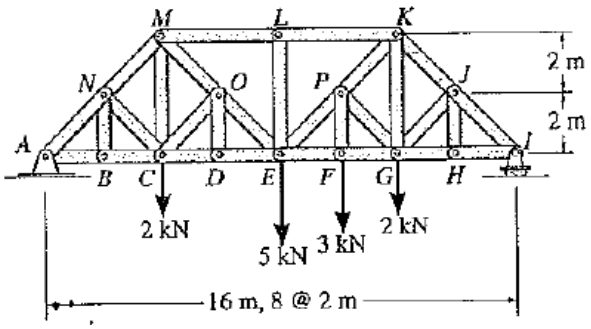
Determine the force in members *GF*, *CF*, and *CD* of the roof truss and indicate if the members are in tension or compression.



ANS: F_{GF}=1.78 kN (T), F_{CD}=2.23 kN (C), F_{CF}=0

Q11.

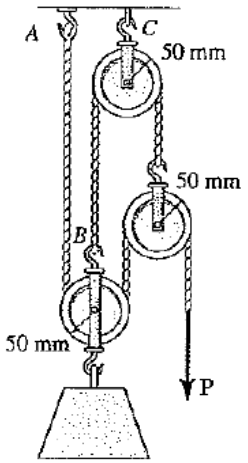
Determine the force in members *EF*, *EP*, and *LK* of the *Baltimore bridge truss* and state if the members are in tension or compression. Also, indicate all zero-force members.



ANS: Iy=6.375 kN, F_{EF}= 7.875 kN (T), F_{LK}=9.25 kN (C), F_{EP}= 1.94 kN (T)

Q12.

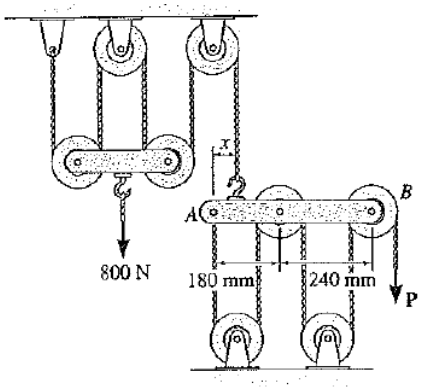
Determine the force **P** needed to support the 100-N (≈ 10-kg) weight. Each pulley has a weight of 10 N (≈ 1 kg). Also, what are the cord reactions at *A* and *B*?



ANS: F_A=25 N, F_B= 60 N

Q13.

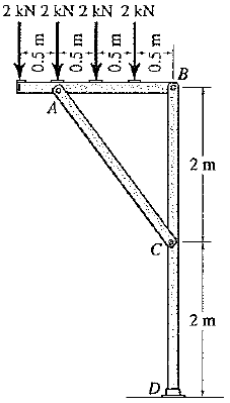
The principles of a *differential chain block* are indicated schematically in the figure. Determine the magnitude of force **P** needed to support the 800-N force. Also, find the distance *x* where the cable must be attached to bar *AB* so the bar remains horizontal. All pulleys have a radius of 60 mm.



ANS: P=40 kN, x= 240 mm

Q14.

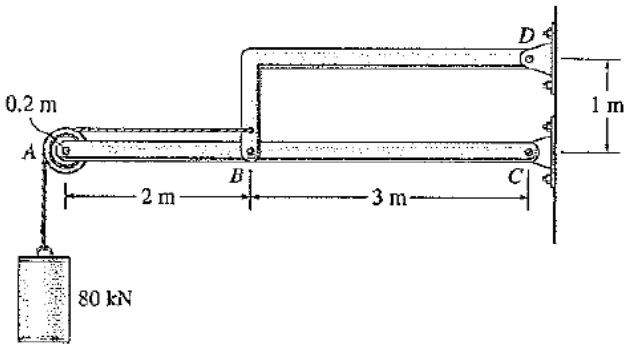
Determine the horizontal and vertical components of force at pins A, B, and C, and the reactions to the fixed support D of the three-member frame.



ANS: By=1.33 kN, Bx= 5.00 kN, Ax=Cx=5.00 kN, Ay=Cy=6.67 kN, M_D=10 kNm, Dy=8.0 kN, Dx=0

Q15.

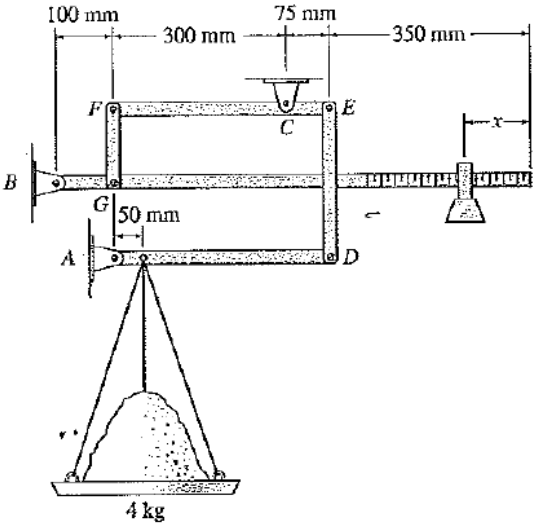
Determine the horizontal and vertical components of force which the pins exert on member ABC.



ANS: Ax=80 kN, Ay= 80 kN, By= 1.33 kN, Bx=336 kN, Cx= 416 kN, Cy=53.3 kN

Q16.

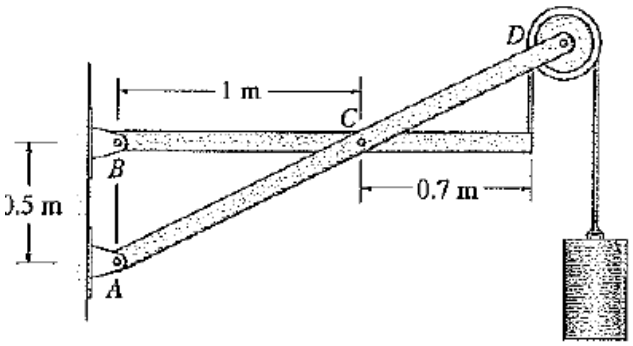
The compound arrangement of the pan scale is shown. If the mass on the pan is 4 kg, determine the horizontal and vertical components at pins A, B, and C and the distance x of the 25-g mass to keep the scale in balance.



ANS: Ay=34.0 kN, Ax=0, Cy=6.54 kN, Cx=0, x=292 mm, By=1.06 N, Bx= 0

Q17.

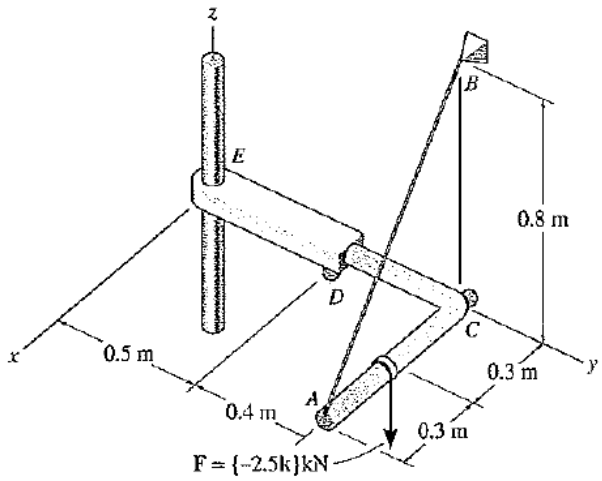
Determine the horizontal and vertical components of force that the pins at A, B, and C exert on the frame. The cylinder has a mass of 80 kg. The pulley has a radius of 0.1 m.



ANS: Cy=1.33 kN, By=549 kN, Cx=2.98 kN, Ay=235 N, Ax=2.98 kN, Bx= 2.98 kN

Q18.

The structure is subjected to the loading shown. Member AD is supported by a cable AB and roller at C and fits through a smooth circular hole at D. Member ED is supported by a roller at D and a pole that fits in a smooth snug circular hole at E. Determine the x, y, z components of reaction at E and the tension in cable AB.



ANS: M_{Ex}=0.5 kNm, M_{Ey}=0, Ey=0, Ex=0, F_{AB}= 1.56 kN