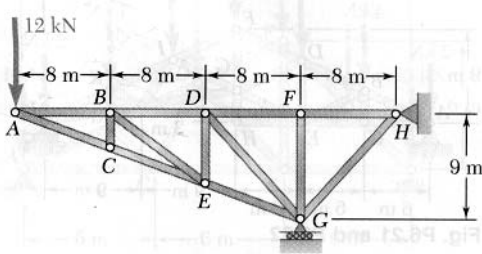
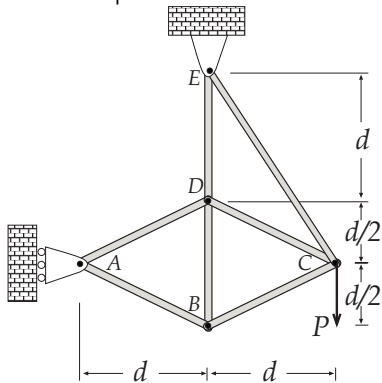


HOMEWORK 4

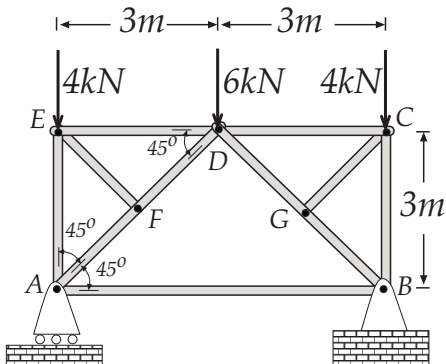
1. Determine the force in each member of the truss shown. State whether each member is in tension or compression.



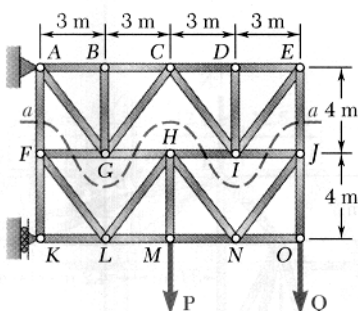
2. Determine the force in each member of the truss in terms of the load P , and indicate whether each member is in tension or compression.



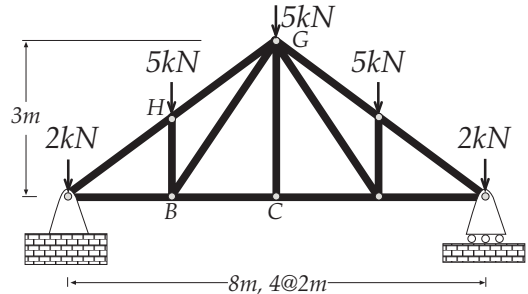
3. Determine the force in each member of the truss, and indicate whether each member is in tension or compression.



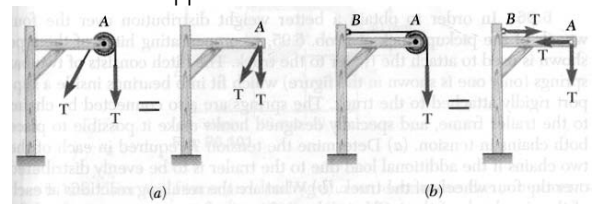
4. Determine the force in members AF and EJ of the truss shown when $P=Q=1.2kN$.



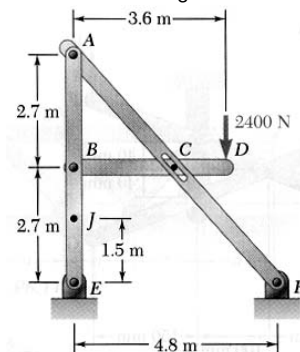
5. Determine the force in members GH , BC , and BG of the truss, and indicate whether these members are in tension or compression.



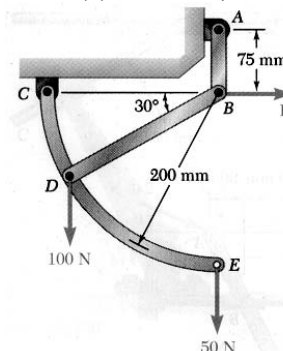
6. (a) Show that when a frame supports a pulley at A , an equivalent loading of the frame and each of its component parts can be obtained by removing the pulley and applying at A two forces equal and parallel to the forces that the cable exerted on the pulley. (b) Show that if one end of the cable is attached to the frame at point B , a force of magnitude equal to the tension in the cable should also be applied at B .



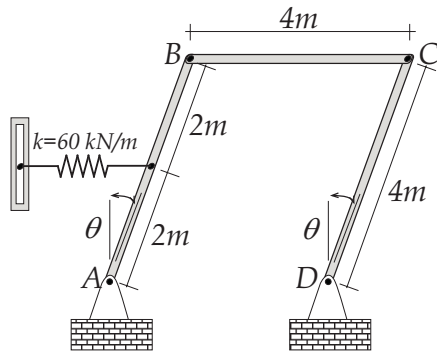
7. For the frame and loading shown, determine the components of all forces acting on member ABE .



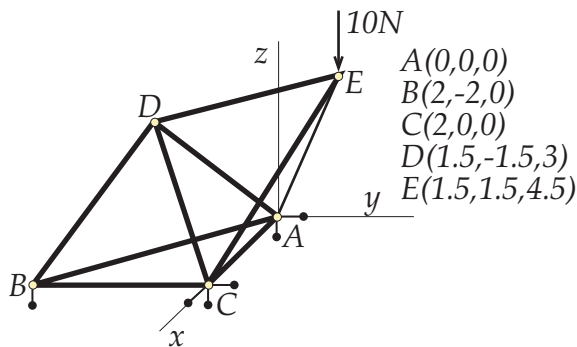
8. For the system and loading shown, determine (a) the Force P required for equilibrium, (b) the corresponding force in member BD , (c) the corresponding reaction at C .



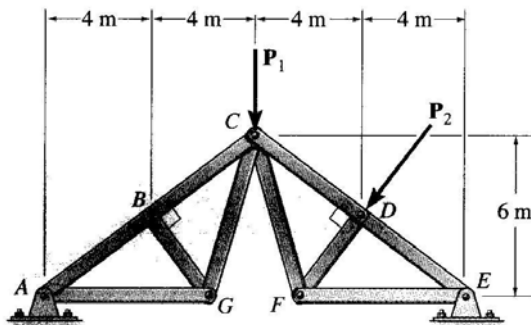
9. If each of the links of the mechanism has a weight of 25 kN , determine the non-zero angle θ for equilibrium. The spring, which always remains horizontal, is unstretched when $\theta = 0^\circ$.



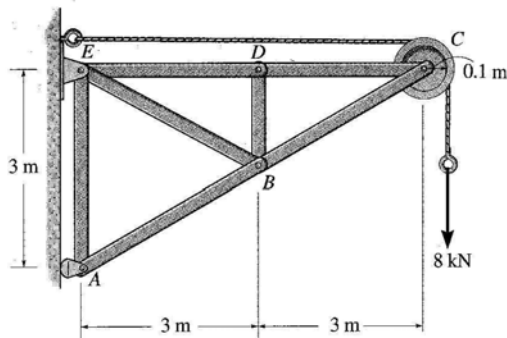
10. Find the force in member BD of the 3-D truss shown. The coordinates of the joints are with respect to an axis placed at joint A. The 3-D truss is held rigidly in space by 6 links, and the links are arranged such that they are parallel to one of x, y, or z. The 10 N force is parallel to the z axis.



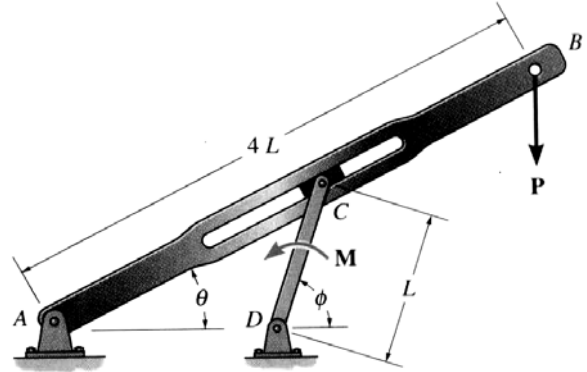
11. Find all bar forces in the truss shown. Take $P_1 = 10\text{ N}$, $P_2 = 10\text{ N}$.



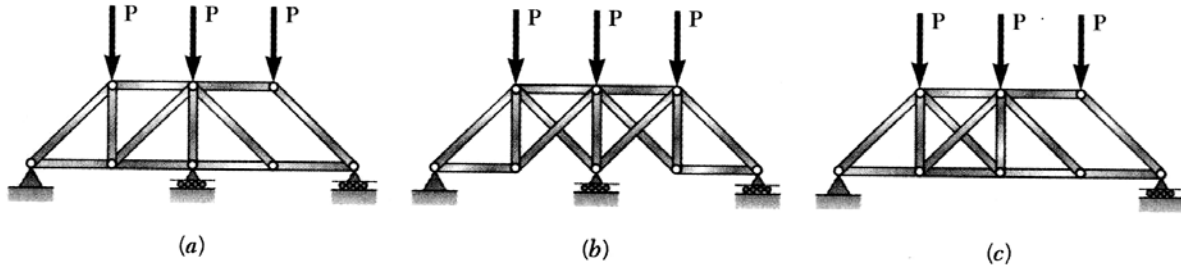
12. Find all bar forces in the truss shown.



13. Determine the couple moment M that must be applied to member DC for equilibrium of the quick-return mechanism. Express the result in terms of the angles ϕ and θ , dimension L , and the applied vertical load P . The block at C is confined to slide within the slot of member AB .



14. Classify each of the structures shown as completely, partially, or improperly constrained; if completely constrained, further classify as determinate or indeterminate. (All members can act both in tension and in compression.)



ANSWERS

1. $AH: 32kN (T)$; $AG: 34.2kN (C)$; $GH: 48.2kN (C)$
2. $ED: 0$; $EC: 1.2P (T)$; $CD, BC, AB, AD: 0.373P (C)$; $BD: 0.333P (T)$
3. $CG, EF, CD, DE: 0$; $DG, DF, BG, AF: 4.24kN (C)$; $AB: 3kN (T)$; $AE, BC: 4kN (C)$
4. $AF: 1.5kN (T)$; $EJ: 0.9kN (T)$
5. $GH: 12.5kN (C)$; $BG: 6.01kN (T)$; $BC: 6.67kN (T)$
7. $A_x: 2025N \leftarrow$; $A_y: 1800N \downarrow$; $B_x: 4050N \rightarrow$; $B_y: 1200N \uparrow$; $E_x: 2025N \leftarrow$; $E_y: 600N \uparrow$
8. $P: 109N \rightarrow$; $BD: 126.8N (T)$; $C_x: 109N \leftarrow$; $C_y: 86.6N \uparrow$
9. $\theta = 33.6^\circ$
10. $BD = 7.71N (T)$
11. $AB = BC = 13.54N (C)$, $CD = DE = 16.46N (C)$, $DF = 10N (C)$, $CF = EF = 8.33N (T)$, $CG = AG = 0$
12. $AB = BC = 8\sqrt{5} kN (C)$, $CD = AE = DE = 8kN (T)$, $BE = BD = 0$
13. $M = \frac{4PL \sin^2 \theta}{\sin \phi} \cos(\phi - \theta)$