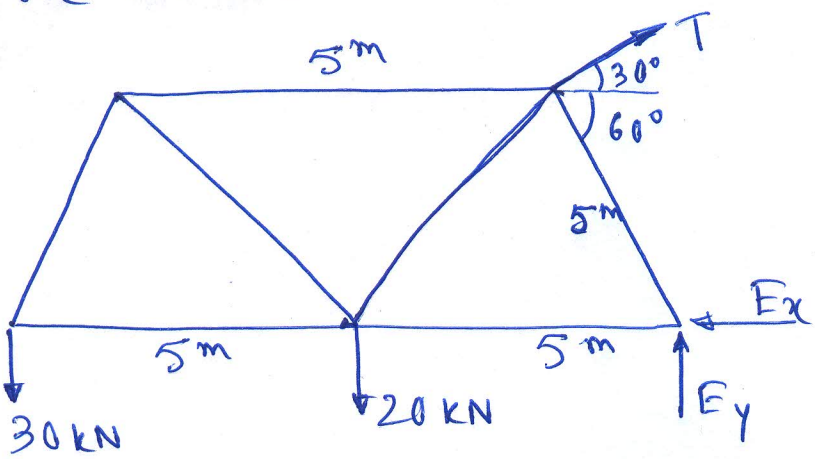
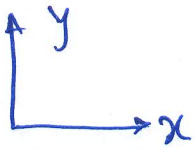
Solution for Problem #2

If it were not desired to calculate the external reactions at D & E, the analysis for a cantilever truss could begin with the joint at the loaded end. However, this truss will be analyzed completely, so the first step will be to compute the external forces at D & E from the FBD of the truss as a whole. The FBD of the whole truss is





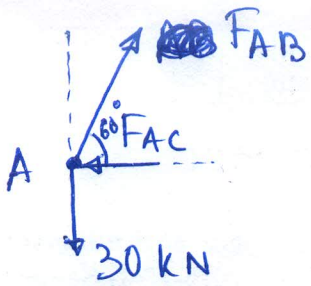
The equations of equilibrium give

$\Sigma M_E = 0$: $\quad 5T - 20(5) - 30(10) = 0 \Rightarrow T = 80\ kN$

$\Sigma F_x = 0$: $\quad 80\cos 30^\circ - E_x = 0 \Rightarrow E_x = 69.3\ kN$

$\Sigma F_y = 0$: $\quad 80\sin 30^\circ + E_y - 20 - 30 = 0 \Rightarrow E_y = 10\ kN$

Next we draw FBDs showing the forces acting on each of the connecting pins. Therefore equilibrium requires



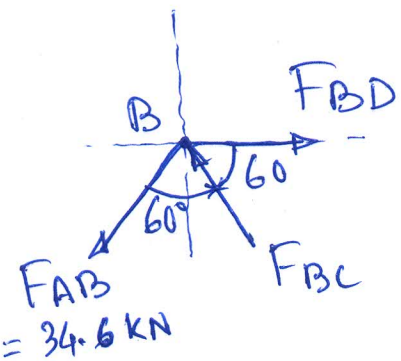
Joint A

$\Sigma F_y = 0$: $(0.866)(F_{AB}) - 30 = 0 \Rightarrow F_{AB} = 34.6$ kN (T)

$\Sigma F_x = 0$: $F_{AC} - (0.5)(34.6) = 0 \Rightarrow F_{AC} = 17.32$ kN (C)

Where T stands for tension & C stands for compression

Joint B must be analyzed next, since there are more than two unknown forces on joint C. The forces are obtained from

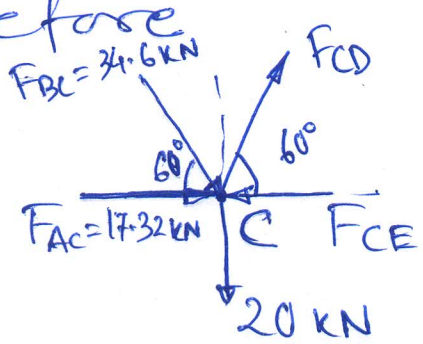


Joint B

$\Sigma F_y = 0$: $(0.866)(F_{BC}) - (0.866)(34.6) = 0 \Rightarrow F_{BC} = 34.6$ kN (C)

$\Sigma F_x = 0$: $F_{BD} - (2)(0.5)(34.6) = 0 \Rightarrow F_{BD} = 34.6$ kN (T)

Joint C now contains only two unknowns, and these are found in the same way as before

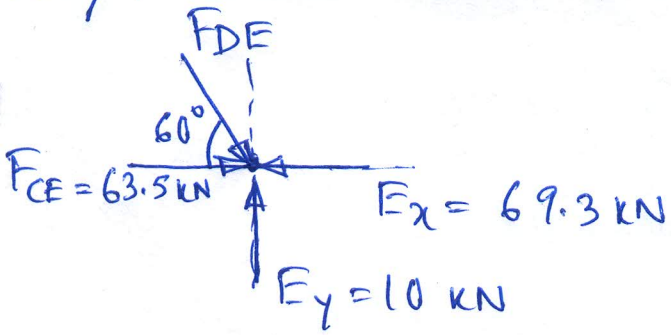


Joint C

$\Sigma F_y = 0$: $(0.866)(F_{CD}) - (0.866)(34.6) - 20 = 0 \Rightarrow F_{CD} = 57.7\,kN\,(T)$

$\Sigma F_x = 0$: $F_{CE} - 17.32 - (0.5)(34.6) - (0.5)(57.7) = 0 \Rightarrow F_{CE} = 63.5\,kN\,(C)$

Finally, from joint E we get



$\Sigma F_y = 0$: $(0.866)(F_{DE}) = 10 \Rightarrow F_{DE} = 11.55\,kN\,(C)$

Therefore forces in each member are

$F_{AB} = 34.6\,kN\,(T)$ $\quad F_{CD} = 57.7\,kN\,(T)$

$F_{AC} = 17.32\,kN\,(C)$ $\quad F_{CE} = 63.5\,kN\,(C)$

$F_{BC} = 34.6\,kN\,(C)$ $\quad F_{DE} = 11.55\,kN\,(C)$

$F_{BD} = 34.6\,kN\,(T)$

Midsem Question 2 Grading Policy

- System force and moment equilibrium equations to compute T, Ex and Ey – ***6 marks***
- *Method of Joints:* 4 marks for each of the 3 joint analysis – ***4 x 3 = 12 marks***

OR

Method of sections: Complete analysis to calculate all forces – ***12 marks***

- Final indication of forces in each member showing correct magnitude and direction (Tension or compression) – ***2 marks***