Example 1.1a – The pin-jointed truss structure in Figure 1 is subjected to a vertical force of 10 kN in joint *F* as shown.

a) Calculate the **degree of redundancy** of the structure.
b) Determine the magnitude and sense of the **reaction forces** at both supports.
c) Determine the magnitude and sense of the **internal forces** in each of the 8 members.

$\beta = 45^\circ$

$\sin\beta = \cos\beta = 1/\sqrt{2}$

$\alpha = \text{atan}\left(\frac{0.9}{1.8}\right)$

$\alpha = 26.6^\circ$

$\sin\alpha \cong 0.447$

$\cos\alpha \cong 0.894$

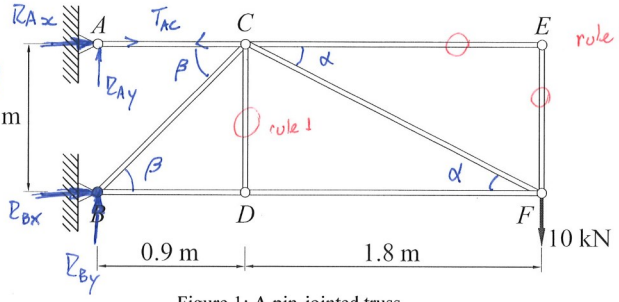


Figure 1: A pin-jointed truss.

N_U = 8 members + 4 reactions = 12

N_e = 6 joints × 2 DoF = 12

$DoR = N_U - N_e = 0$

Global Equilibrium

$\sum M^{cw}_{@B} = 0$

$(10\,kN)(2.7m) + R_{Ax}(0.9m) = 0$

$R_{Ax} = -30\,kN$

$\sum F_x = 0$

$R_{Ax} + R_{Bx} = 0$

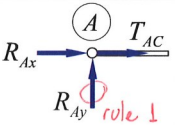
$R_{Bx} = 30\,kN$

$\sum F_y = 0$

$(-10\,kN) + R_{By} = 0$

$R_{By} = 10\,kN$

$\sum F_y = 0$



$\sum F_x = 0$

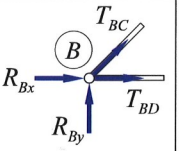
$R_{Ax} + T_{AC} = 0$

$T_{AC} = 30\,kN$

$\sum F_y = 0$

$R_{By} + T_{BC}(\sin\beta) = 0$

$T_{BC} = -14.14\,kN$

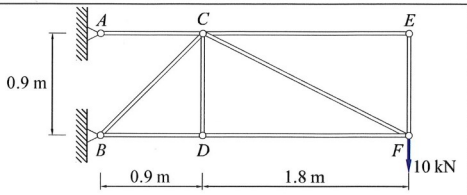


$\sum F_x = 0$

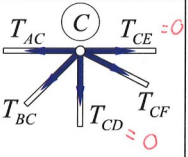
$R_{Bx} + T_{BD} + T_{BC}(\cos\beta) = 0$

$(30\,kN) + T_{BD} + (-14.14\,kN)\cos\beta = 0$

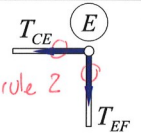
$T_{BD} = -20\,kN$



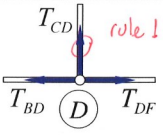
- Remember to start your analysis from joints of known forces or reactions.
- This particular problem was solved by applying the "rules of collinearity" and the analysis of joints A, B and F.
- By doing so we avoided joint C which was the most difficult to analyse !



$T_{CE} = 0$



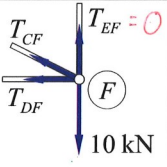
$T_{EF} = 0$



$\Sigma F_y = 0$

$(-10\ kN) + T_{CF}(\sin\alpha) = 0$

$T_{CF} = 22.36\ kN$



$\Sigma F_x = 0$

$-T_{DF} - T_{CF}(\cos\alpha) = 0$

$T_{DF} = -20\ kN$