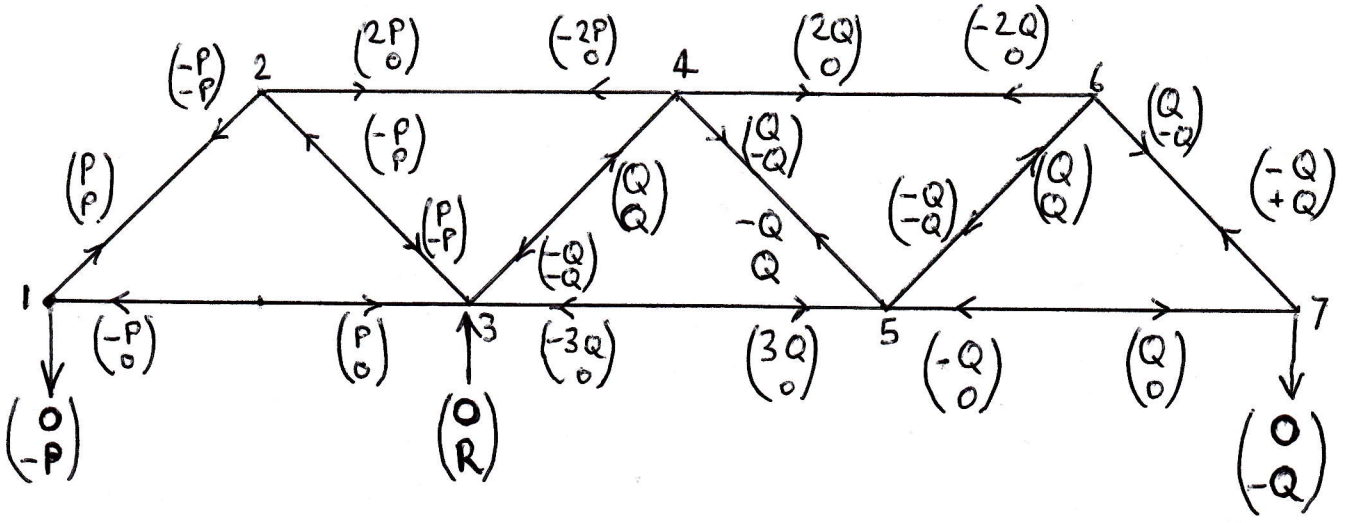
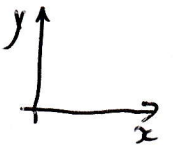
BALANCING WITHOUT USING PRINCIPLE OF MOMENTS

A 2:1 see-saw is made as a pin-jointed structure of 11 struts and ties ....



Forces on pins 1–7 are shown as column vectors with x-components on top, y-components underneath.



All 'angled' struts or ties are at 45°. This means that the forces they exert on the pins must all be of form $\begin{pmatrix}S\\S\end{pmatrix}$, $\begin{pmatrix}S\\-S\end{pmatrix}$, $\begin{pmatrix}-S\\S\end{pmatrix}$ or $\begin{pmatrix}-S\\-S\end{pmatrix}$.

'Load' forces of magnitude P and Q act downwards on pins 1 and 7. Pin 3 is the fulcrum, experiencing an upward force R.

We then use equilibrium of → and ↑ forces at each pin.

Order of procedure is to determine forces at pin 1 and hence at pin 2. Then start afresh at pin 7, then 6, then 5. This enables us to put in the forces at pin 4, in terms of P and Q.

Using horizontal force equilibrium at pin 4:

$$-2P + 4Q = 0 \qquad \text{So} \qquad P = 2Q$$

This is just what we'd get from Principle of Moments!

[Finally we can determine the forces at pin 3, finding $R = P+Q$.]