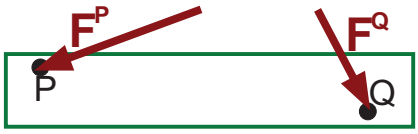
12.3 Two force members. PRE-LAB PROBLEM!

The following figure to the right shows a relatively light (massless) "***two-force member***"[1] with a contact force $\mathbf{F}^P$ applied to point P from a pin-joint (not shown) and a contact force $\mathbf{F}^Q$ applied to point Q from another pin-joint.

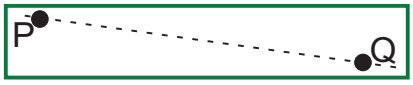


- Prove the forces have equal magnitude and opposite direction, i.e,

$$\mathbf{F}^P = \text{-}\mathbf{F}^Q$$

- Prove the forces are parallel to the line connecting P and Q, i.e.,

$$\mathbf{r}^{Q/P} \times \mathbf{F}^P = \mathbf{0} \quad \text{and} \quad \mathbf{r}^{Q/P} \times \mathbf{F}^Q = \mathbf{0}$$



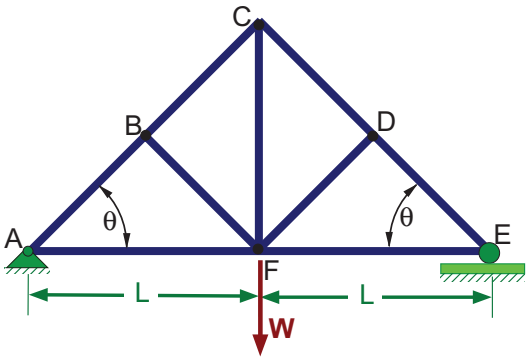
- Sketch $\mathbf{F}^P$ and $\mathbf{F}^Q$ to the right.

12.4 Static analysis of a truss. PRE-LAB PROBLEM!

Trusses are an important engineering structure because they have a high strength-to-weight ratio, i.e, they are light relative to the loads they carry.

Some trusses are designed to carry loads in a plane and have "***two-force members***" (i.e., forces are applied to the ***member*** at two distinct points).

The figure to the right shows a truss that is in **static equilibrium** and is attached to ground at point A by a pin-joint and point E by a pin-roller joint.



After completing the 2^{nd} column in the following table using your engineering intuition (or **guessing**),[2] perform a static analysis and verify your guess. Use $W = 200$, $L = 5$, and $\theta = 40°$.

Note: The magnitude of the forces in members CD, DF, DE, and FE can be determined via symmetry.

Member	Guess (circle one)	Force magnitude	Compression or tension
AB	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
AF	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
BF	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
FC	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
FE	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
CB	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
CD	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
DF	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**
DE	**Compression/Neutral/Tension**		**Compression/Neutral/Tension**

From the analysis just performed, do members BF and DF serve any structural purpose? **Yes/No**.
Why might an engineer add members BF and DF?

[1] A ***two-force member*** is a structural object with only **two** forces on it.

[2] A member is in ***tension*** if the forces on it are trying to elongate it, whereas a member is in ***compression*** if the forces on it are trying to shorten it.