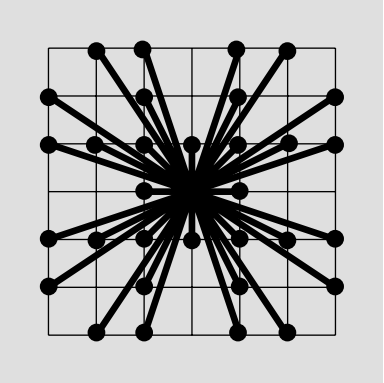

FIGURE 16.5. The members connected to a single interior joint.

of a member would be proportional to the square root of the cross-sectional area). Also, those members under compression are drawn in dark gray, whereas those under tension are drawn in light gray. Note that the compression members appear to cross the tension members at right angles. These curves are called *principle stresses*. It is a fundamental result in continuum mechanics that the principle tension stresses cross the principle compression stresses at right angles. We have discovered this result using optimization.

Most nonexperts find the solution to this problem to be quite surprising, since it covers such a large area. Yet it is indeed optimal. Also, one can see that the continuum solution should be roughly in the shape of a leaf.

Exercises

16.1 Show that a matrix R is skew symmetric if and only if

$$\xi^T R \xi = 0, \qquad \text{for every vector } \xi.$$

16.2 Which of the structures shown in Figure 16.7 is stable? (Note: each structure is shown embedded in a convenient coordinate system.)

16.3 Which of the structures shown in Figure 16.7 is a truss?

16.4 Assuming that the total applied force vanishes, show that total torque is translation invariant. That is, for any vector $\xi \in \mathbb{R}^d$,

$$\sum_i (R(p_i - \xi))^T b_i = \sum_i (R p_i)^T b_i.$$

16.5 In 3-dimensions there are 5 regular (Platonic) solids. They are shown in Figure 16.8 and have the following number of vertices and edges:

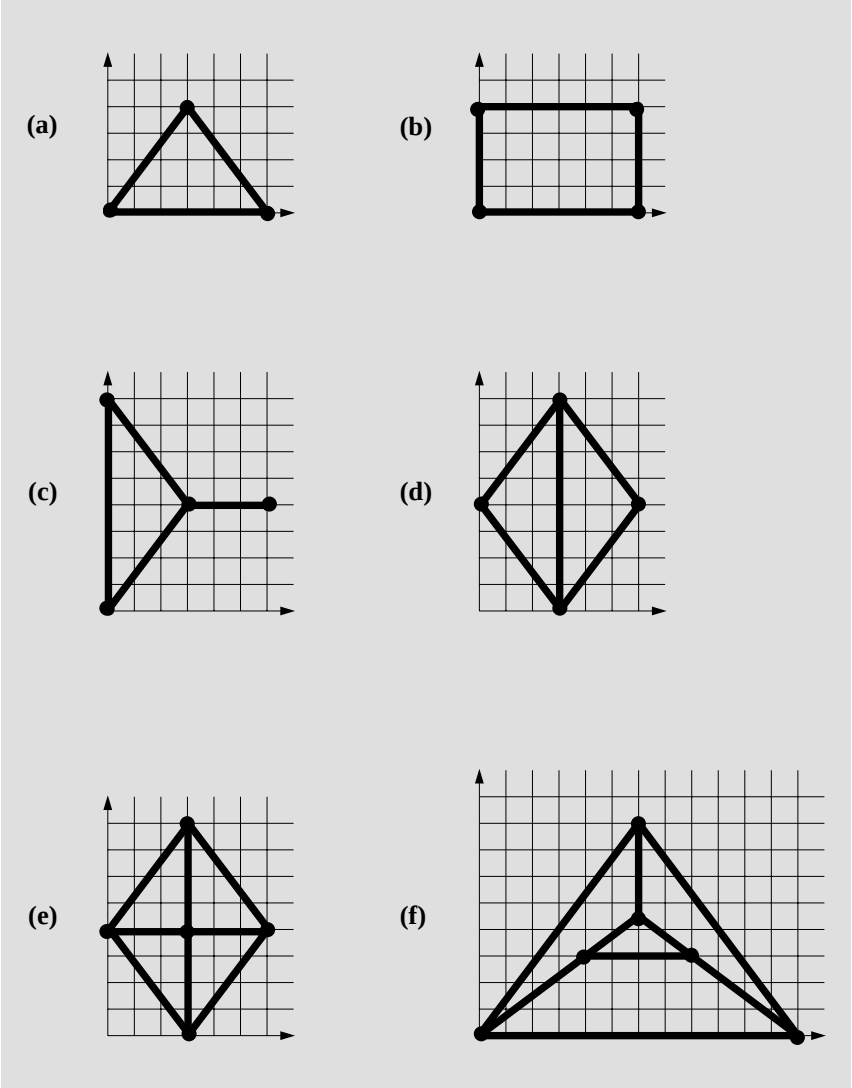

FIGURE 16.7. Structures for Exercises 16.2 and 16.3.